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Volume III. Summary of Previous Air Quality Studies and Data

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In response to Congressional mandates, the U. S. Environmental Protection Agency will conduct an extensive study of air pollution related problems in the Texas Gulf Coast Area. As an initial effort, EPA awarded a contract to review the existing technical information and record the local viewpoint on air pollution problems in the area, define research needs, and design experimental studies addressed to these needs. Results are presented in 5 volumes. Volume III summarizes previous air quality studies and presents technical data.

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Volume III. Summary of Previous Air Quality Studies and Data

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ABSTRACT

This document contains a summary of all available air pollution related information concerning air pollution - emissions, measurements, and meteorology - for the Texas Gulf Coast Area (Houston area). Included is a summary of major reports and studies covering air quality in the Houston area, with conclusions and recommendations, as well as air pollution emissions data summaries, air quality monitoring site information, air quality data summaries, and additional meteorological information. Finally, a bibliography with abstracts is provided for the topics of emissions, monitoring, meteorology, and control, which are relevant to the Texas Gulf Coast Study.

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SECTION 1

INTRODUCTION AND SUMMARY

The Texas Gulf Coast Area is the largest urban and industrial area in the southern United States. Local citizens, governmental agencies and corporations have a longstanding interest and concern with the quality of life in this area. Many groups have sponsored and/or performed research and monitoring of air quality and environmental health in the greater Houston area since the 1960's. The results of the studies have identified several outstanding questions that need resolution. The U.S. Congress mandated that the Environmental Protection Agency, in cooperation with local groups, plan and execute a program to define the health problems resulting from air pollutions in the Gulf Coast Area.

Additional information concerning the Texas Gulf Coast Planning Study, of which this document is a part, are provided in the following:

- Volume I. Plan for Air Quality Studies
- Volume II. Plan for Health Effects Studies
- Volume IV. Summary of Previous Health Effects Studies and Data
- Volume V. Local Viewpoints on Research Needs

The objective of Volume III is to collect, catalogue, and summarize all available air pollution related information relevant to the Houston area, including:

- air pollutant emissions data,
- air quality measurements,
- meteorological data, and
- pertinent aerometric research studies.

A map of the Texas Gulf Coast area is provided in Figure 1-1. Included in the study area are all of the counties in the Houston and Galveston Standard Metropolitan Statistical Areas (Brazoria, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties), with the addition of

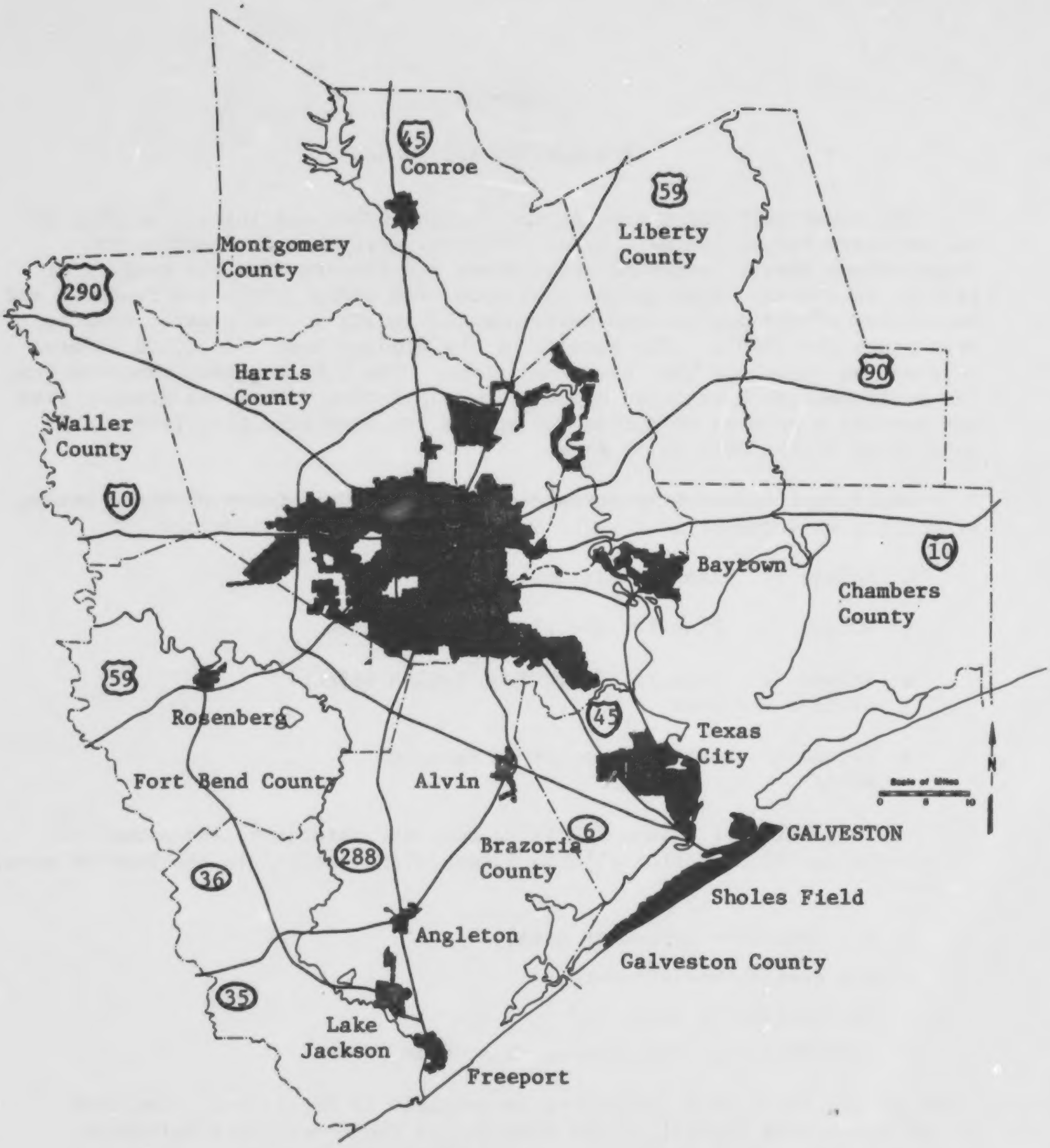
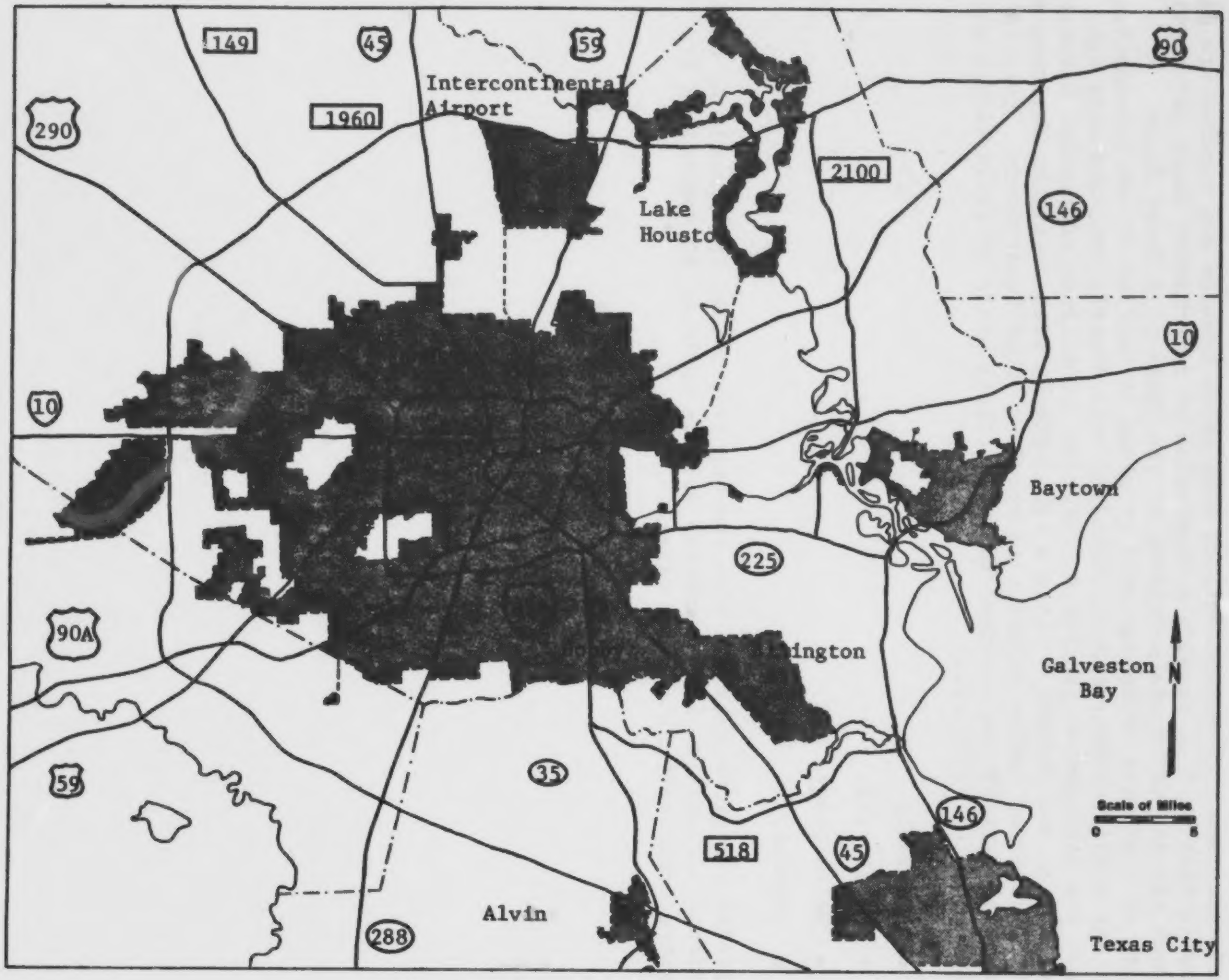

45
Conroe
59
Liberty
County
Montgomery
County
290
Harris
County
90
Waller
County
10
Baytown
10
Chambers
County
59
Rosenberg
45
Texas
City
Fort Bend County
Alvin
Scale of Miles
0 5 10
N
6
GALVESTON
288
Brazoria
County
36
Sholes Field
Angleton
Galveston County
35
Lake
Jackson
Freeport

Figure 1-1. Texas Gulf Coast Study Area.


149
45
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90
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1960
Intercontinental
Airport
Lake
Houston
2100
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10
10
Baytown
225
90A
ington
Galveston
Bay
N
59
35
146
Scale of Miles
0
5
518
45
288
Alvin
Texas City

Figure 1-2. Immediate Houston vicinity.

Chambers County. A close-up map of the immediate Houston vicinity is shown in Figure 1-2.

Conclusions and recommendations from major reports and studies are presented in Section 2 to provide a foundation of information about aerometric research studies which are pertinent to the Texas Gulf Coast Study. A summary of available emissions data is given in Section 3, and information about air quality measurements, including site descriptions and data summaries, are provided in Section 4. Section 5 describes additional meteorological data, and Section 6 lists a bibliography with abstracts covering air pollution related topics relevant to the Texas Gulf Coast Study. Entries in the bibliography are arranged in alphabetical order by title within each of the following categories:

- Emissions,
- Monitoring,
- Meteorology, and
- Control.

Additional emissions data for area sources is provided in Appendix A, and additional air quality data summaries will be included in Appendix B (to be issued separately at a later date).

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS FROM MAJOR REPORTS AND STUDIES

Included in this section are summaries, conclusions, and recommendations from important studies that are relevant to the Texas Gulf Coast Study. Nine reports and studies sponsored by the EPA, NASA, Texas Air Control Board, and Houston Chamber of Commerce are described. The summaries, conclusions, and recommendations have been presented directly from the source documents where possible. Entries are arranged in chronological order, according to the period of most intensive study.

TITLE:	Respirable Particulate Monitoring with Remote Sensors, Public Health Ecology: Air Pollution
PERIOD OF STUDY:	July 1, 1971 - October 31, 1973
SPONSORING AGENCY:	National Aeronautics and Space Administration
PERFORMING ORGANIZATION:	The University of Texas, Institute of Environmental Health, Health Sciences Center at Houston

SUMMARY: The feasibility of monitoring atmospheric aerosol characteristics in the respirable range from air or space platforms was explored and demonstrated. The research plan included elements from contrast theory, Mie aerosol characteristics, and a vertical path length, limited by the altitude of the remote sensor platform, an aircraft, or the height of the inversion layer.

Secondary reflectance targets were located in the industrial area and near Galveston Bay. These approximated areas of high and low ambient air aerosol loadings. Film/filter channels were used to limit bandwidths. Multichannel remote sensor data was processed and utilized to calculate the aerosol extinction coefficient, and thus determine the aerosol size distribution.

Houston and Texas air sampling network high-volume suspended particulate data were utilized to generate computer isopleth maps (SYMAPS) of suspended particulates over the test site areas. On-site 5-hour high-volume measurements were also conducted to establish the mass loading of the atmosphere. In addition, a 5-channel nephelometer, and a multi-stage particulate air sampler were used to collect data at the site. After demonstrating the data best fit the Junge distribution, linear regression analyses were used to calculate the extinction coefficient.

The empirical models in the literature were utilized to predict ambient air mass loadings. The extinction coefficient determined from remote sensor data proved more representative of wide areal phenomena than that calculated from on-site measurements. It was also demonstrated that a significant reduction in the standard deviation of the extinction coefficient could be achieved by reduction in the size of the bandwidths used in remote sensors. This technology and software may be transferable to use with satellite information.

CONCLUSIONS AND RECOMMENDATIONS: The results of this study are not conclusive but do indicate that some of the characteristics of the ambient respirable aerosol concentration can be monitored with remote sensors from high air-space platforms. Most easily measured is the extinction coefficient q, of the aerosol size distribution. This then can be used to predict the mass loading on a time averaged basis. Thus far the prediction of mass loading has not been highly successful but several characteristics have emerged. A 24-hour mass loading of the ambient atmosphere representative of large areas is more likely to be predicted successfully utilizing q than anything representative of purely local ground conditions. The extinction coefficient q can itself be shown to distinguish between aerosols which have sorbed moisture and those that are relatively dry. In fact, the extinction coefficient q calculated from remote sensor data is far more closely related to relative humidity than that q calculated from nephelometric ground truth measurements.

Recommendations for future research include the following:

1. ERTS or other satellite frequency band data should be utilized to calculate extinction coefficients for the aerosol size distribution contained under the temperature inversion.

2. These techniques should be utilized with active remote sensors. The Environmental Protection Agency Remote Sensing Laboratory at Las Vegas, Nevada has developed the capability to determine inversion altitudes with lasers mounted in airplanes. A joint program should be explored.

3. Passive or active remote sensors should be used which have well known, narrow, frequency bandwidths. The multi-band spectral analyzer is an example of one such preferred sensor.

4. New contrast targets should be chosen that can be resolved (defined) with multichannel analyzers or other narrow multi-band frequency sensors. A new black secondary reflectance target would be most useful since it would also eliminate some difficulties in the analyses. The shadow limb of the white tank used in these studies as the black secondary reference standard was thought to be too narrow to be resolved with present multichannel analyzer capability.

5. Gaseous air pollutants which cause degradation of health in humans should be monitored by remote sensors by utilizing the spectral qualities of these pollutants, e.g., organic gases, oxides of nitrogen, carbon monoxide, ozone, and exploiting the concepts and techniques herein developed.

TITLE:	Particulate Attainment Analysis
PERIOD OF STUDY:	1971-1975
PERFORMING ORGANIZATION:	Texas Air Control Board

SUMMARY: Section 110 of the Federal Clean Air Act requires that each State Implementation Plan be revised whenever it is determined that the plan is substantially inadequate to achieve the national ambient air quality standards. The FY 76 State Program Grant from the Environmental Protection Agency to the Texas Air Control Board required that the Board conduct attainment analyses for primary suspended particulate standards in several air quality control regions in Texas. These attainment analyses were to include as a minimum:

- a detailed evaluation of the status of air quality,
- an evaluation of the restrictiveness of existing regulations, and
- an evaluation of the status of major compliance programs.

CONCLUSIONS AND RECOMMENDATIONS: As a result of this analysis of major compliance programs, the following conclusions have been reached:

1. Ninety-seven of the 103 major sources located in Harris County are in substantial compliance with Regulation I. Of the six remaining sources not yet in compliance, two are in some phase of legal action while the other four are implementing control programs to reduce emissions to comply with the regulation.

2. Future reductions in excess of 96 tons per year of particulate matter are anticipated by the end of 1977 for major source abatement programs. Additional reductions totaling over 800 tons per year are anticipated in the next few years.

3. Only one minor source of the 47 identified within the area of study is not in substantial compliance with Regulation I. The City of Houston Air Pollution Control Program is working with this company to solve its emissions problems.

4. Area sources within the study area were determined to be in substantial compliance with Regulation I.

5. Emissions from major sources do not exceed the allowables a significant amount of time due to upset and maintenance activities. The amount of

particulate emissions exceeding the allowables during these upset and maintenance operations is significant.

6. No trends in complaints could be identified. Correlations analysis revealed poor correlation between time and the number of complains received during the 23 month study period.

7. The intent of Rule 104 is being complied with by most affected sources with the exception of several large unpaved public commercial parking lots which may product substantial amounts of airborne particulates especially during employee shift changes.

This report on the status of major compliance programs in Harris County has been as extensive and complete as possible given the short time available for the study. Recommendations on additional work necessary are listed below:

1. A comprehensive review of Rule 104 should be undertaken to determine if its clarity can be improved.

2. Additional study beyond the scope of this report is desirable to determine the impact on ambient air quality of upset and maintenance activities in the area.

TITLE:	Urban and Industrial Air Pollution in Houston, Texas - I. Hydrocarbons.
PERIOD OF STUDY:	July 1973 and July-August 1974.
SPONSORING AGENCY:	Environmental Protection Agency
PERFORMING ORGANIZATION:	University of Houston, Department of Chemical Engineering, Air Quality Management Program

SUMMARY: During the Summer of 1973 and 1974, ambient air samples were collected at sites in downtown Houston and the nearby Pasadena and LaPorte industrial complex to determine the hydrocarbon composition in relation to emission sources. Ground level samples were collected at one hour intervals and analyzed for C_1 - C_6 hydrocarbons without delay in order to avoid any sample deterioration due to storage. In addition at selected times, helicopters were used to sample at 500 and 1000 ft elevation. Meteorological conditions were recorded and their effects on the hydrocarbon composition evaluated. As expected, the hydrocarbon spectrum of downtown Houston air resembled that of auto exhaust and showed a strong dependence on traffic density and local meteorology. The hydrocarbon composition at the industrial sites largely depended on the wind direction and magnitude, (i.e., local point sources). This study has also indicated removal of some of the hydrocarbons by the photochemical reactions.

CONCLUSIONS AND RECOMMENDATIONS: This study has provided, for the first time, a picture of the hydrocarbon composition and temporal variation of Greater Houston's ambient air in relation to emission sources. The study has indicated that both automobile and industrial processes are important to the hydrocarbon problem in Houston. In the downtown area automobiles do contribute more to the pollution burden as the frequency of olefins has been found greater in downtown than the other two sites. It has also been shown that these hydrocarbons do undergo photochemical reactions.

A summary of non-methane hydrocarbon levels at all sites is shown below. It is apparent that 1974 non-methane hydrocarbon concentration in Pasadena decreased as compared to 1973. The decrease in hydrocarbon concentration in Pasadena can be attributed to the implementation of the Regulation V (Control on volatile carbon compounds) of Texas Air Control Board. Regulation V required industries to control hydrocarbons from a variety of sources (e.g., floating roofs for storage tanks, better maintenance of pumps and valve leaks, etc.) and, as expected, these activities have resulted in reducing the concentration of non-methane hydrocarbons in air.

The decrease in the levels of airborne hydrocarbons is in line with the 46% reduction in the stationary source emissions which has been achieved because of the Regulation V of the Texas Air Control Board.

Hydrocarbon composition has shown a strong dependence on the wind direction at Pasadena and La Porte sites. This would indeed be expected as these sites are surrounded by a variety of manufacturing operations (hydrocarbon sources).

COMPARISON OF LEVELS OF NON-METHANE HYDROCARBONS IN 1973 AND 1974

	Downtown		Pasadena		La Porte
	1973	1974	1973	1974	1974
Total No of Samples	79	298	102	278	108
% of Samples >0.24 ppm	12.7	4.4	32.3	16.5	4.6
% of Samples <0.24 ppm	87.4	95.6	67.6	83.5	95.4
% of Samples <0.05 ppm	27.8	30.2	22.5	52.9	75.9
% of Samples containing olefins	80.0	61.0	21.0	10.0	4.0

TITLE:	Hydrocarbon Analysis of Houston Air
PERIOD OF STUDY:	September 1, 1973, January 30, 1974, and April 2, 1974.
PERFORMING ORGANIZATION:	U.S. Environmental Protection Agency

SUMMARY: A total of 21 air samples were collected at various urban, industrial, and rural locations in the Houston area and these samples were analyzed by gas chromatograph to determine individual hydrocarbons. Estimates of vehicular hydrocarbons at the different sites were made by comparing certain hydrocarbon/acetylene ratios with those collected in a tunnel under the Houston ship channel. The tunnel samples were assumed to be representative of pure automobile emissions.

CONCLUSIONS AND RECOMMENDATIONS:

A significant contribution from non-vehicular hydrocarbon sources was observed at most of the sampling sites. At some of the locations, as little as 10-15% of the hydrocarbon burden could be attributed to vehicular sources. For samples considered to be most representative of vehicular and industrial emissions, approximately 50% of the total hydrocarbons could be attributed to vehicular sources. Also, ratios of non-methane hydrocarbons to oxides of nitrogen were found to be typical of such ratios in other large urban areas, ranging from about 10/1 to 20/1.

TITLE: Light Hydrocarbon Measurements at Houston

PERIOD OF STUDY: October 8-19, 1973

SPONSORING AGENCY: U.S. Environmental Protection Agency

PERFORMING ORGANIZATION: Washington State University

SUMMARY: Light hydrocarbons (C_1 - C_5) were monitored, as well as total non-methane hydrocarbons, NO_x, and O_3. Also, O_3 was measured by aircraft.

TITLE: Houston Urban Plume Study - 1974. Description and Summary of Results.

PERIOD OF STUDY: July 15-24, 1974

SPONSORING AGENCY: Environmental Protection Agency, Environmental Sciences Research Laboratory

PERFORMING ORGANIZATION: University of Texas at Austin

SUMMARY: The 1974 Houston Urban Plume Study (HUPS) was undertaken as a preliminary investigation of some of the unresolved features of Houston's air pollution problem. HUPS was intended specifically to gain limited information on the spatial and temporal distribution of air pollutants -- particularly, primary and secondary aerosols -- in the Houston area as an aid should a later intensive investigation of aerosol character and transport be needed.

Aerial measurments were made of the principal pollutants (SO_2, NO_x, O_3, CO, aerosol) of the Houston area. Wind-field measurements were also made. These data were used to estimate pollutant budgets. Values for SO_2 and NO_x (14 metric tons/hr and 40 metric tons/hr, respectively) were reasonably comparable with values derived from emissions inventories of the Texas Air Control Board (13 and 24 metric tons/hr, respectively). On the basis of the limited sampling period, the industrial area (east of downtown Houston) apparently is the major contributor of primary air pollutants in the Houston area. In the morning hours above the mixed layer, relatively large ozone concentrations (max. 0.2 ppm) -- almost certainly of photochemical origin -- were found that correlated closely with light scattering aerosol, thus indicating the existence above the mixed layer of strong secondary aerosol sources.

Appendices containing all the data are not included in this report. A complete, unabridged report is available from the National Technical Information Service (NTIS) as EPA-600/3-78-048a, May 1978.

This report was submitted in partial fulfillment of Grant No. R800871 by the University of Texas, Austin, under the sponsorship of the Environmental Protection Agency. This work was completed as of March 31, 1976.

CONCLUSIONS AND RECOMMENDATIONS:

The 1974 Houston Urban Plume Study (15-24 July, 1974) had as its objective a preliminary investigation of some of the unresolved features of Houston's air pollution problem. The principal tool in this investigation was an instrumented fixed wing aircraft. The following conclusions derived from the study are based on limited data representing seven days (18-24 July, 1974) of actual operation.

1. Pollutant budgets for the Houston area for SO_2 and NO_x (14 metric tons/hr and 40 metric tons/hr, respectively) were found to be in reasonable compari-

son with values derived from emissions inventories of the Texas Air Control Board (13 and 24 metric tons/hr, respectively).

2. On the basis of the limited sampling period, it appears that the industrial area (east of downtown Houston) is the major contributor of primary air pollutants in the Houston area.

3. During the period of the study, in the morning hours above the mixed layer, relatively large ozone concentrations (max. 0.2 ppm) - almost certainly of photochemical origin - were found which were correlated closely with light scattering aerosol. This correlation indicated the existence above the mixed layer of strong secondary aerosol sources, possibly associated with the oxidation of SO_2.

This preliminary study has served to indicate more clearly what additional studies are needed to delineate the aerosol character and transport in the Houston area. The most important recommendations are:

1. Future field studies in the Houston area should be preceded, planned, and carried out adaptively with an adequate air pollution model for the Houston area.

2. These studies should integrate ground based and aircraft measurements, preferably involving two or more aircraft. At least one helicopter would be desirable to permit sampling below 1000 feet (304.8 m.) owing to frequent low level nighttime inversions in the Houston area.

3. The studies should be of sufficient duration to permit an adequate sampling of meteorological conditions and diurnal and seasonal variations.

4. Special attention should be given to characterization of primary sources and background values for the principal air pollutants - particularly for particulate matter.

5. The test of an adequate delineation of the aerosol transport and character for the Houston area can only be in the form of predictive success of an air pollution model developed previously and adapted extensively from field results.

It is safe to say that studies in the Houston area which proceed without these elements cannot be decisive in resolving the nature of Houston's air pollution problem.

TITLE: Photochemical Oxidant Attainment Analysis.
Summary and Analysis of Ozone Data.

PERIOD OF STUDY: 1974-1976

PERFORMING ORGANIZATION: Texas Air Control Board

SUMMARY: Texas Air Control Board (TACB) data have shown that the national ambient air quality standard for photochemical oxidants (ozone) has not been attained in nine of the twelve air quality control regions (AQCRs) in Texas. As part of the Environmental Protection Agency's Requirement for submittal of revisions to the State Implementation Plan, statistical data on ambient ozone levels were produced for each AQCR. The data are summarized and presented in this report for the Austin-Waco, Corpus Christi-Victoria, Houston-Galveston, Dallas-Forth Worth, San Antonio, Beaumont-Port Arthur, El Paso, Midland-Odessa-San Angelo and Texarkana-Tyler AQCRs. This report does not address the complex relationship between hydrocarbons, oxides of nitrogen and ozone in the ambient atmosphere nor is there an in-depth examination of the ozone-forming potential of typical weather systems occurring in Texas. This additional analysis will be essential in order to determine if the oxidant standard is attainable in any of these nine air quality control regions.

Examination of ozone data collected through the Texas Air Control Board's continuous ambient monitoring network shows that:

1. The photochemical oxidant standard has been exceeded at each of the 20 TACB continuous monitoring stations currently operating in nine AQCRs in the state.

2. The highest ozone concentrations and the greatest frequency of values over the standard occur at stations in the Houston-Galveston and Beaumont-Port Arthur AQCRs.

3. Other statistical measures, in addition to the annual second highs, such as the percent of hours and days with ozone above 0.080 ppm, ninetieth percentile values and the number of hours above higher concentration levels, show that ozone concentrations in 1976 were significantly higher than in 1974 and 1975.

4. Meteorological conditions that were conducive to ozone formation occurred more frequently in August and September of 1976 than during the same period in 1974 and 1975.

CONCLUSIONS AND RECOMMENDATIONS: The photochemical oxidant standard has been exceeded at every continuous monitoring station operated by the Texas Air Control Board. In 1976, the second highest one-hour concentrations ranged from less than twice the standard in Austin to almost three and one-half times the standard in the Houston ship channel area. The stations located in the upper Gulf Coast area of Texas consistently measure the highest ozone concentrations and experience levels above the standard for the longest durations. The six stations in this area (Aldine, Houston, Texas City, Nederland, West Orange and Clute) averaged levels over two and one-half times the standard based on 1976 second high hourly values. Central Texas cities (Austin, Dallas, and San Antonio) averaged twice the standard while the stations in El Paso and Corpus Christi averaged less than twice the standard in 1976.

Studies conducted by the Texas Air Control Board have shown that the oxidant standard has been exceeded in rural areas of Texas which were not directly affected by manmade precursor emissions. High ozone concentrations (up to 0.081 ppm) have been measured at CAMS locations when air parcels entering the cities arrived at monitoring sites from non-urban, non-industrial area. This information, coupled with the results of another TACB study on the relationship of hydrocarbon emission reductions and ambient ozone concentrations, casts doubt on the achievability of the oxidant standard in Texas' major metropolitan areas.

In addition, there is evidence that ozone concentrations in rural areas may exceed the standard for longer durations than in urban areas. Preliminary data from the Gregg County CAMS in the Texarkana-Tyler AQCR show that this station may have a higher percentage of values above 0.080 ppm than even stations in the Houston and Texas City areas. The occurrence of this phenomenon in rural areas may be due to the lower emissions of NO, which would scavenge the ozone at night.

There is not yet adequate data to determine, with any certainty, whether the ozone levels measured in Texas are consistently increasing or decreasing. Weather conditions in 1976, especially in the late summer months, were sufficiently different from previous years to mask any developing oxidant trends.

An indication of the change in patterns of ozone behavior in 1976 was the increase in the number of long duration ozone buildups. In 1974 there were 14 instances of daily high ozone concentrations exceeding 0.080 ppm for four or more consecutive days at single monitoring locations. In 1975, there were 10 such instances, but in 1976 the number jumped to 39. The longest episodes were in Aldine and Dallas in August 1976. The ozone reached levels above the standard for ten consecutive days at each location.

In 1976, high pressure systems dominated the states' weather during the late summer. Comparisons with data for the same period in 1974 and 1975 show that in 1976 wind speeds were significantly lower and the percentages of possible sunshine significantly higher across the state. Ozone levels in June and July 1976 were similar to previous years.

The Texas Air Control Board deployed six new continuous monitoring stations in late 1976 and early 1977. The three remaining stations, necessary to complete the network, will be deployed before the end of FY-77. They will be located in Nueces County, Arlington and Bexar County. Ozone statistics from the recently deployed stations were not discussed in detail in this report because, traditionally, the highest ozone levels are recorded in the period from July to October.

TITLE: Study of the Formation and Transport of Ambient Oxidants in the Western Gulf Coast and North Central and Northeast Regions of the United States.

PERIOD OF STUDY: July 1 - October 1, 1975

SPONSORING AGENCY: Environmental Protection Agency

PERFORMING ORGANIZATION: Research Triangle Institute

SUMMARY: During the summer of 1975, Research Triangle Institute (RTI) conducted a two-part field measurement program designed (1) to determine the change in the concentration of ozone in the center of a high pressure system, as the system moves from an area of low population density to an area of high population density; and (2) to determine the areal extent of high ozone concentrations in the northern gulf coast region of Texas.

In the Northern High Pressure System Oxidant Study, the objective was to determine the change in the concentration of ozone near the center of high pressure systems, as these systems traverse the northwestern, north-central, and northeastern areas of the United States. During their passage over the United States, these systems traverse, first, regions of low population density and little industrial activity -- that is, regions having small emission densities of the hydrocarbon and nitrogen oxide precursors necessary for the production of the photochemical oxidants. During this initial period, low ozone concentrations were anticipated. As the systems move eastward, however, population density, industrial activity, and, consequently, emissions of oxidant precursors increase. It was anticipated that ozone levels would increase.

The objective of the Gulf Coast Oxidant Study was to document the areal extent of high ozone concentrations in the northern gulf coast region of Texas. Primary emphasis was on the roles and/or contribution of land-sea breeze circulations, of local emissions of ozone precursors, and of transport of ozone and ozone precursors within and downwind of the study areas.

Design of Study/Field Measurement Program

To accomplish the objectives described above at a minimum cost, two independent studies were designed that could be conducted concurrently and that employed similar measurement systems.

Based on the above considerations, two modes of measurement were employed: (1) a network of five, fixed, rural sites operated by RTI plus supplementary rural and urban ground-level sites operated by State/local/other agencies, and (2) an instrumented aircraft flying specified patterns. The field measurement program included continuous ozone and nitrogen dioxide measurements, collection of grab samples for selected hydrocarbon and halocarbon analyses, and 24-hour, total suspended particulate (TSP) samples at four manned, rural stations located in Bradford, Pennsylvania; Creston, Iowa; Wolf Point, Montana; and DeRidder, Louisiana. Ozone measurements were also made at an unmanned station at Lewisburg, West Virginia, and at supplementary stations located in the general study areas, which were operated by State and local governments or by private industry. Ozone and oxides of nitrogen were measured and grab samples collected during aircraft flights designed to accomplish specific objectives for each study area. Supplemental vertical ozone data were obtained from ozonesonde releases at Huron, South Dakota, and DeRidder, Louisiana. A joint RTI-EPA quality assurance program was designed and implemented to assure that high quality data were obtained.

The data acquisition program began at all stations before July 1, 1975. Data were collected and quality assurance performance audits were performed at specified intervals at each of the stations included in the monitoring network through September 30, 1975, at northern stations and through October 31, 1975, in the South.

Since only one aircraft was utilized for both studies, the aircraft was based in DeRidder, and flights were conducted in the gulf coast area until an appropriate high pressure system developed in the northern study area. A total of 111 individual aircraft flights were flown during the combined studies. These flights were flown under varying meteorological conditions and included sea breeze flights, coastal areal survey flights, downwind plume flights, vertical profile flights, double-box patterns around Nederland, Texas, calibration and instrument checkout flights, and northern high pressure system flights. During the month of October, several joint RTI-EPA/Las Vegas flights were flown in the gulf coast area.

Principal Findings

The data obtained during the field measurement program were summarized statistically and segmented into four general subject areas for analysis and interpretation. These areas are: (1) Northern High Pressure Oxidant Study, (2) Gulf Coast Oxidant Study, (3) Chemistry of Ozone Generation in Rural Areas, and (4) Quality Assurance Program. Data were analyzed and interpreted according to the objectives for each study and have been incorporated into a comprehensive section that combined both a chemical and meteorological interpretation of the results. Principal findings are presented separately below.

Gulf Coast Oxidant Study

1. Air moving slowly over areas of large hydrocarbon emissions was associated with upper decile ozone concentrations at urban and rural locations in the gulf coast area. In most cases, trajectory analysis showed air with high ozone concentrations arrived from nonprevailing directions.

2. Air that moved rapidly, showed weak anticyclonic curvature, and had long overwater fetches was associated with lower decile ozone concentrations at all of the ground station locations.

3. In most cases, trajectory analysis attributed the highest ozone concentrations to principal cities or areas of high precursor emissions located in the gulf coast study area. These observations suggest that ozone plumes commonly develop downwind of large precursor emissions areas.

4. Aircraft ozone measurements clearly demonstrate an ozone plume (280 $\mu g/m^3$, maximum) upon a low ($\sim 100\ \mu g/m^3$) background downwind of the petrochemical complex at Port Arthur, Texas. During the period observed, ground level ozone concentrations at a continuously operating ground station near the emission area were less than 100 $\mu g/m^3$.

5. Intercity urban plume transport of ozone or ozone precursor materials was evident. This was shown as a potential cause of some violations of the NAAQS at Austin.

6. In the survey flights, the mean ozone concentrations over water were usually found to be less than those over the land, regardless of the level of ozone encountered. When elevated ozone concentrations were measured over the water, the trajectory analyses usually showed the air parcel had a recent ($\sim$24 hr) history over continental areas, usually over high precursor emission areas.

7. When areawide ozone concentrations exceeded the NAAQS, vertical mixing was usually restricted by a stable layer below 2 km.

8. Analysis of a series of ozonesonde releases at DeRidder, Louisiana, does not indicate ozone intrusion from the stratosphere. Mid-to-upper tropospheric ozone concentrations changed by 50 percent or more during a day, but they did not contribute to ozone changes at ground level.

9. Anthropogenic pollutants (acetylene and selected halocarbons) were present in all grab samples collected at the DeRidder station and during aircraft flights. Examination of the data indicate that hydrocarbon and ozone concentrations are not linearly related at DeRidder.

10. Four distinct areal distributions of ozone were identified from aircraft flights:

   a) area-wide low concentrations ($\sim 70\ \mu g/m^3$),

   b) localized plumes downwind of precursor areas,

   c) elevated ozone concentrations, some exceeding NAAQS for ozone, usually increasing from west to east,

   d) area-wide (North Carolina to Louisiana) ozone concentrations exceeding the NAAQS for ozone.

CONCLUSIONS AND RECOMMENDATIONS:

Conclusions: Gulf Coast Oxidant Study

1. Ozone concentrations over the Gulf of Mexico usually were less than those over land. High ozone concentrations (i.e., $\geq 160\ \mu g/m^3$) that were measured over water or in air flowing off the Gulf of Mexico were associated with air that had previously passed over continental sources of pollution.

2. Changes in the vertical structure of ozone concentrations below 3 km are parimarily controlled by boundary layer processes.

3. Elevated ozone concentrations (i.e., $\geq 160\ \mu g/m^3$) are frequently measured in plumes downwind of potential ground sources of precursors, i.e., cities, major refineries, and petrochemical installations.

4. Upper decile concentrations of ozone are associated with slow moving air that had passed over high precursor emission areas and arrived from a non-prevailing wind direction; lower decile concentrations are associated with faster moving air, having a long over-water fetch with a weak anticyclonic trajectory.

TITLE: Measurement of Light Hydrocarbons and Studies of Oxidant Transport Beyond Urban Areas, Houston Study - 1976

PERIOD OF STUDY: 1 July 1976

SPONSORING AGENCY: U. S. Environmental Protection Agency, Environmental Sciences Research Laboratory

PERFORMING ORGANIZATION: Washington State University, Chemical Engineering Department

SUMMARY: During the month of July, 1976, Washington State University carried out an extensive air pollutant monitoring program in the Houston area. This field study involved ground sampling plus use of an instrumented aircraft. Measurements included ozone, oxides of nitrogen, PAN, methane, carbon monoxide, individual hydrocarbons (C_2 - C_{10}), halocarbons, condensation nuclei and visual distance plus numerous meteorological parameters. Specific areas of interest in this study included: 1) oxidant formation and transport within the Houston urban plume, 2) relationships between ozone layers aloft and the vertical temperature profile, 3) composition and effects of refinery and petrochemical emissions on the local Houston air mass, and 4) identification and quantitation of individual C_2 - C_{10} hydrocarbons in the Houston atmosphere. Results of this field program are presented with special emphasis placed on oxidant production and transport in the Houston area.

CONCLUSIONS AND RECOMMENDATIONS: Hydrocarbon concentrations (6-9 am) at three ground level sites in the Houston area generally fell in the range of 200-1000 $\mu g/m^3$. However, there were occasions when the hydrocarbon total exceeded 2000 $\mu g/m^3$. The extreme hydrocarbon concentrations ($> 2000\ \mu g/m^3$) were most often observed at the site in north Houston. On mornings when hydrocarbon concentrations in the 2000-3000 $\mu g/m^3$ range were recorded, it was common to find as much as 90% of the hydrocarbon burden comprised of aromatic species. Afternoon hydrocarbon levels at the WSU trailer site in northwest Houston averaged about a factor of three lower than those measured during the 6-9 am period.

Background hydrocarbon concentrations averaged about 40 $\mu g/m^3$. Samples collected in air masses containing elevated ozone exhibited hydrocarbon concentrations in the 200 $\mu g/m^3$ range and thus were considerably above the background level. The hydrocarbon content that could be ascribed to automotive tailpipe emissions between 6 and 9 am at the three sampling sites varied from 25 to 31%. A similar vehicular content (∿25%) was determined from hydrocarbon samples collected by aircraft in the downwind Houston plume.

Ozone concentrations at the WSU trailer site equalled or exceeded the 80 ppb NAAQS on seven of the 25-day sampling period. It was not uncommon for aircraft measured ozone concentrations to exceed 80 ppb on days when ground level concentrations were much below the standard. There is little doubt that ozone concentrations in the region downwind of Houston generally exceed those monitored at ground level stations in the Houston urban-industrial complex. Between July 1 and 24, 1976 there were no "blanket" ozone episodes in southern Texas. Consequently, we believe that oxidants measured in the Houston area during the July study period resulted from precursors emitted in the immediate Houston area. There was no evidence of surface ozone enhancement due to subsiding air masses from aloft.

The presence of PAN in the Houston atmosphere was primarily limited to the daylight hours. Elevated PAN concentrations were observed to persist into the nighttime hours only on two occasions. The highest hourly average PAN concentration was 11.5 ppb; however, the average of all measurements between 10 am and 4 pm was only 1.0 ppb. On a daily basis there existed a good correlation between PAN and ozone. On days when ozone showed high peak values, PAN concentrations peaked as well.

The Houston plume was detectable for long distances downwind. Aircraft data collected on July 12, clearly show a pronounced ozone plume as far as 90 miles downwind of Houston. Ozone levels approaching 190 ppb were recorded at that distance and they remained elevated over a cross-sectional distance of about 45 miles. A reduction in visual range always coincided with elevated ozone in the downwind plume.

Hydrocarbon - NO_x ratios during the 6-9 am period generally fell in a range of 7.5 to 18.5 at the northwest Houston ground sampling site. Similar Hc/NO_x ratios were observed in air masses that contained high oxidant levels. On several occasions the ground level, diurnal, pollutant patterns in Houston were consistent with a photochemical oxidant producing mechanism.

Ambient fluocarbon-11 concentrations averaged between 400 and 650 ppt in northwest Houston. This is high when compared to average background concentration in upwind areas of about 140 ppt. This difference was used as an aide for tracing the Houston plume. Ground level carbon tetrachloride concentrations averaged about 300 ppt in Houston and showed little diurnal variation.

Samples collected in the Houston vicinity for sulfate analysis exhibited concentrations ranging from near zero to 10.8 $\mu g/m^3$. In general, highest sulfate levels were recorded in areas downwind of the ship channel industrial area.

TITLE:	Houston Area Oxidant Study (HAOS)
PERIOD OF STUDY:	1975-1977
SPONSORING AGENCY:	Houston Chamber of Commerce

SUMMARY: The Houston Area Oxidants Study (HAOS) is a technical study composed of a group of separate, interrelated projects. The study investigates the causes and impacts of airborne oxidants and haze in Houston and Southeast Texas. It is an effort to develop a sound technical basis for controlling haze and airborne oxidants in the area.

At the end of 18 months of activity, the HAOS as a whole is now approximately 80 percent complete. Ten projects have submitted draft final reports which are currently undergoing review. Three projects are actively reducing data and preparing draft reports. The socio-economic impact study is in the process of refining impact models and developing analysis techniques. Four contracts have recently been awarded, three in the area of data analysis and one in the ozone/oxidants study area.

The HAOS is sponsored by the Houston Chamber of Commerce. It is directed by the HAOS Steering Committee, a special committee of the Chamber. There are two sub-committees, the Technical Sub-Committee and the Advisory Sub-Committee. The Technical Sub-Committee is responsible for the technical design and credibility of the study, the Advisory Sub-Committee for financial support. A private technical consulting firm, Radian Corporation, provides technical and fiscal management services for HAOS. Funds for HAOS have been generated from private sectors of the Houston community, including individuals, business, industry, universities, labor unions, construction firms, banks and real estate developers.

HAOS is a cooperative effort between environmental contractors, independent private businesses and governmental agencies. Data obtained from some HAOS projects are being augmented by data from the public and private sectors. The value of this additional data, if financed by HAOS, would add over $4 million to the $1.4 million HAOS budget. Private sources of data include Exxon Corporation, Celanese Chemical Company, Dow Chemical Company, General Motors, Gulf Chemical Company, Houston Lighting and Power Company, Monsanto, Arco Chemical, DuPont, and Shell Oil Company. Cooperating public agencies include the Texas Air Control Board (TACB), the Environmental Protection Agency (EPA), and the City of Houston.

HAOS has received national attention because of its unique organization and sponsorship when the recent (1977) amendments to the Clean Air Act were formulated. Congress cited HAOS as an example of private initiative to study air pollution problems. EPA has recently provided $1 million for an initial study of the relationship between airborne aerosols and health in the Gulf

Coast area. Expenditure of an additional $2 million during the next two years is being considered by EPA for subsequent studies in the area. HAOS cooperated with TACB in its efforts to obtain federal funds for this project, and is providing technical data to EPA in support of these studies.

Areas of Study

HAOS includes technical studies in four subject areas: ozone/oxidants, haze, health effects, and socio-economic impact of control measures. Studies in the ozone/oxidants and haze areas have collected and processed data which will provide a more complete characterization of air quality in the Houston area. Data obtained from the health effects studies will better define the effects of air quality on community health. A study of the socio-economic impact of control measures is developing a scientific methodology for projecting impacts and analyzing the consequences of probable control strategies. Progress in pertinent areas of study is described below.

Air Quality Definition: Ozone/Oxidants

During June - October, 1977, data describing levels of ozone, nitrogen oxides (NO_x), ultraviolet radiation, and a wide variety of specific hydrocarbons were collected at monitoring sites throughout the Houston area. These data were augmented by meteorological information regarding two- and three-dimensional air movements, and by documentation of ozone episodes during the sampling period. In addition to these studies, a contract to design a captive air chamber for examination of pollutant behavior in large samples of captive air was awarded April 1, 1978.

Air Quality Definition: Haze

Little is known about Houston's most evident air quality problem: reduced visibility resulting from light scattering by particles in the atmosphere. For this reason, three HAOS projects in the haze study area conducted field sampling during June - October, 1977. Visibility measurements were made using both trained human observers and instrumental methods. These studies were supported by one in which visibility-reducing particles were collected and chemically analyzed.

CONCLUSIONS AND RECOMMENDATIONS: A Program Summary Report, in which all HAOS results will be interpreted and documented, will be published by April 1979.

TITLE: Houston Air Pollution Study (HAPS)

PERIOD OF STUDY: September 15 - October 15, 1978

SPONSORING AGENCY: Environmental Protection Agency

SUMMARY: A one month intensive field study was conducted in the Houston area by several public and private organizations. In addition to routine data from the TACB, City of Houston, and National Weather Service, data was gathered from nine additional stationary monitors, two mobile vans, a twin engine airplane, helicopter, tethersonde, acoustic sounder, two piball sites, and four portable pairs of TSP Hi-Vol samplers. Five of the stationary monitors collected continuous ozone and NO_x data, in addition to the TACB and City of Houston monitors. Continuous SO_2 was measured at four of the seven additional monitors, with CO and hydrocarbons measured at two of these sites. Freon and PAN were also measured at two of the stationary sites. Three hour integrated grab samples were collected at 10 sites for 6-9 am and 1-4 pm and were analyzed for detailed hydrocarbon species. Grab samples for detailed hydrocarbon analysis were also collected by the two aircraft. Dichotomous particulate samples were collected at the two TACB continuous monitoring sites and with two mobile samplers. Filter samples from the dichotomous samplers, as well as the portable Hi-Vols were analyzed by GC/MS and microscopy. Also, Be^7 and P^{32} measurements were performed.

The airplane also measured ozone with flights conducted 6-9 am and 1-3 pm. Most of the flights remained within about a 50 mile radius from Houston. The helicopter also collected aerosol samples, in addition to grab bag samples. Both of the mobile vans were equipped with an electrical aerosol analyzer and an optical particle counter to measure particle size distribution, condensation nuclei counter, nephelometer, and instruments to measure O_3, NO, NO_x, SO_2, and in one van, THC.

Vertical profiles of wind speed and wind direction were measured hourly in the mornings and occasionally during the afternoons by pilot balloons tracked by theodolite. This wind data, as well as meteorological forecasts were used to determine the daily direction of the urban and industrial plumes. The mobile monitors were then directed to locations to provide cross-sections of the plumes and upwind measurements.

CONCLUSIONS AND RECOMMENDATIONS: Conclusions and recommendations will be reported by June 1979.

SECTION 3

EMISSIONS DATA

There are two major sources of emission inventories for the Gulf Coast Area providing both point source and area source emission data. These are the Texas Air Control Board (TACB) and the EPA Region VI Office in Dallas. Other surveys and inventory updates are currently planned or are in progress and will be available within a year. These will be cited in the following paragraphs.

Point or Stationary Sources

The most recent inventory data for all pollutants from TACB is based on 1973 surveys which have been updated to 1975 and projected to reflect emissions for the year 1980, 1985 and 1990. The inventory includes detailed information about the types of sources, the types and quantity of emissions from each source, and the locations of each source. The compounds inventoried include NO_x, SO_x, hydrocarbons, carbon monoxide, particulates, and specific carbon and nitrogen compounds. Figure 3-1 summarizes the type of data available from the TACB emissions inventory questionnaires. Table 3-1 shows the total carbon compound and NO_x emissions from stationary sources for individual counties in the Houston and Galveston Standard Metropolitan Statistical Areas (SMSA). The 1977 State Implementation Plan (SIP) inventory of emissions of non-methane volatile organic compounds from point sources in Harris County is presented in Table 3-2. It is based on the 1975 inventory and updated with permit data.

The TACB emissions inventory data is also available in the NEDS (National Emissions Data System) format from the EPA Regional Office in Dallas. The NEDS data has the advantage of being in computerized form but is not as complete as the TACB emissions inventory questionnaires.

The 1975 inventory of point source emissions prepared by TACB is available as a listing from computer tape, giving the geographical coordinates of the plants and/or stacks and the annual emissions of HC, NO_x, SO_x and particulates.

So that the location and magnitude of these sources may be visualized more graphically the annual emissions of each pollutant for each industrial plant in the Houston area have been plotted on the maps in Figures 3-2 through 3-5.

STORAGE TANK DATA

Emission Point Number	Tank Capacity (1000 Gal)	Type Tank (Fixed Roof) (Float Roof) (Pressure)	Material Stored	Mol* Wt	Net** Monthly Thru-Put (1000 Gal)	Vapor Pressure PSIA @ °F	Control Pressure (PSIG)	Type Vapor Control	Avg Eff (%)	Vent (Tons/Year)

LOADING AND UNLOADING

Emission Point Number	Type Transfer (Cars, Trucks Ships, Barges, Pipe Line)		Name of Material	Mol* Wt	Monthly Thru-Put (1000 Gal)	Vapor Pressure	Vapor Recovery		Bottom Loading		Splash Loading		Vapor Loss (Tons/Year)
	Load	Unload				PSIA @ °F	Yes	No	Yes	No	Yes	No	

STREAM COMPOSITION AND STACK DATA

1	2			3			4	5	6				
Emission Point Number	Stream Composition			Normal Flow Rate of Each Component			Total Flow Rate (Tons/Year)	Latitude Longitude (To The Nearest Second)	Stack or Vent Information				
	Component	Mol Wt	Conc.	Gas	Particulate				Height Above Ground (Ft)	Inside Diam At Exit (Ft)	Temp (°F)	Velocity (Ft/Sec)	Total Flow Rate (ACFM)
				SCFM (70°F)	Lb/Hr	% Fines							

TOTAL EMISSIONS

Emission Point Number	Emission Point Type	Nitrogen Oxides	Sulfur Dioxide	Carbon Compds.	Carbon Monoxide	Particu-lates	H_2S	H_2SO_4	Fluo-rides	NH_3	Cl_2	HCl	Other

Figure 3-1. Texas Air Control Board emission inventory data format.
Source: TACB

TABLE 3-1. ANNUAL EMISSIONS FROM STATIONARY SOURCES IN HOUSTON-GALVESTON SMSA, 1975
(Emissions are expressed in tons/year)

EMISSIONS	COUNTY							Total SMSA
	Brazoria	Ft. Bend	Galveston	Harris	Liberty+*	Montgomery	Waller+	
Total Carbon Compound Emissions	50,487	628	48,622	149,026	250	9,362	5,363	263,738
Non-Methane Total	29,411	114	44,852	130,222	86	4,418	0	209,103
Process Total	21,537	98	38,931	82,705	0	4,401	0	147,672
Stack or Vent	11,992	98	12,077	30,716	0	4,401	0	59,284
Fugitive	9,536	0	25,261	51,978	0	0	0	86,775
Upset	9	0	1,593	11	0	0	0	1,613
Storage & Load Total	7,865	16	5,882	47,229	0	17	0	61,009
Regulated	1,803	0	1,865	12,004	0	0	0	15,672
Unregulated	6,062	16	4,017	35,225	0	17	0	45,337
Combustion Total	9	0	39	288	86	0	0	422
Methane Total	21,076	514	3,770	18,804	164	4,944	5,363	54,635
Process	12,363	406	505	6,802	158	2,365	3,747	26,346
Storage & Load	0	0	121	0	0	0	0	121
Combustion	8,713	108	3,144	12,002	6	2,579	1,616	28,168
Total NO_x Emissions	54,732	300	41,135	91,978	981	6,521	4,562	200,209
Combustion	54,261	300	39,530	90,742	981	6,521	4,562	196,897
Non-Combustion	471	0	1,605	1,236	0	0	0	3,312

*Data obtained from computer printout of 1973 Emissions Inventory.
+Non Reg 5 - regulated total calculated assuming Reg. V applicable.

TABLE 3-2

POINT SOURCE
SIP EMISSIONS INVENTORY

NON-METHANE VOLATILE ORGANIC COMPOUNDS

(TONS/YR)

COUNTY: Harris YEAR 1977

Bricks and Related Products	0
Carbon Black	5111
Petroleum Refining	
• Fixed Roof Liquid Storage	10305
• Floating Roof Liquid Storage	6688
• Ship and barge transport of gasoline and crude oil	10297
• Vacuum systems, separators, process unit turnarounds	12989
• Fugitive Emissions (leaks)	7325
Other petroleum refinery emissions	12393
Petrochemical Manufacturing	
• Process streams	18180
• Fugitive (leaks)	18384
• Storage and Handling	3497
• Waste Disposal	56
Other petrochemical emissions	78
Asphalt batching	0
Asphalt roofing	0
Power plants	0
Steel production	1176
Foundry	0
Fertilizer and Agriculture Pesticides	67
General Chemicals	
• Paint manufacture	689
• Pharmaceutical manufacture	244
Other general chemical emissions	1573
Wood Products	
• Surface coating of flat wood products	10
• Surface coating of wood furniture	0
Other wood products emissions	0
Fabricated metal products	
• Large appliance manufacture	0
• Metal furniture manufacture	1
• Surface coating of automobiles, cans, metal coils	2234
• Surface coating of other metal products - industrial	0
Other fabricated metal products emissions	95
Oil Mills	
• Vegetable oil processing	0
Other oil mill emissions	0
Fabricated textile products	
• Surface coating of fabric products	0
Other textile products emissions	0
Veneer and Plywood	
• Surface coating of flat wood products	0
Other veneer and plywood emissions	0
Paper, Paperboard and Paperboard Boxes	
• Surface coating of paper	0
Other paper and paperboard emissions	0
• Printing and Publishing	0
• Fabricated rubber products	317
Plastic Products	607
Electrical and Electronic	
• Magnet wire insulation	0
• Surface coating of other metal products - industrial	0
Other electrical and electronic emissions	0
Refuse Systems	0
Federal Facilities	0
Natural Gas Processing Plants (compressor & booster stations)	85
Crude Oil Production	961
Terminals, bulk hydrocarbon	
• Gasoline bulk plants	1284
• Bulk Gasoline Terminals	5165
Other emissions from terminals	4179
Plastics and resins	15267
Synthetic Rubber	397
• Degreasing	8839
TOTAL - POINT SOURCES (T/Yr)	148493

• (CTG ITEMS)

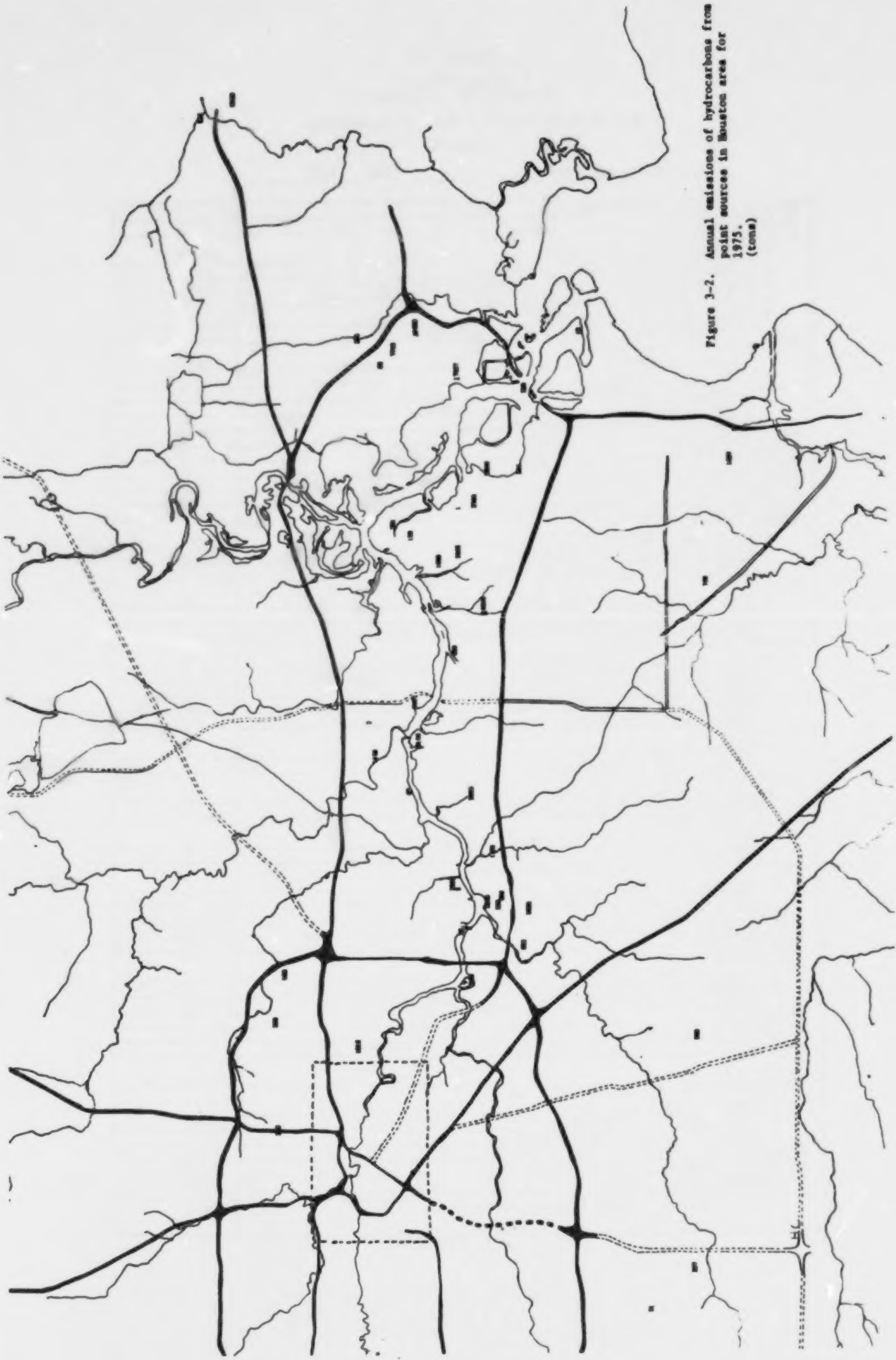


Figure 3-2. Annual emissions of hydrocarbons from point sources in Houston area for 1975. (tons)

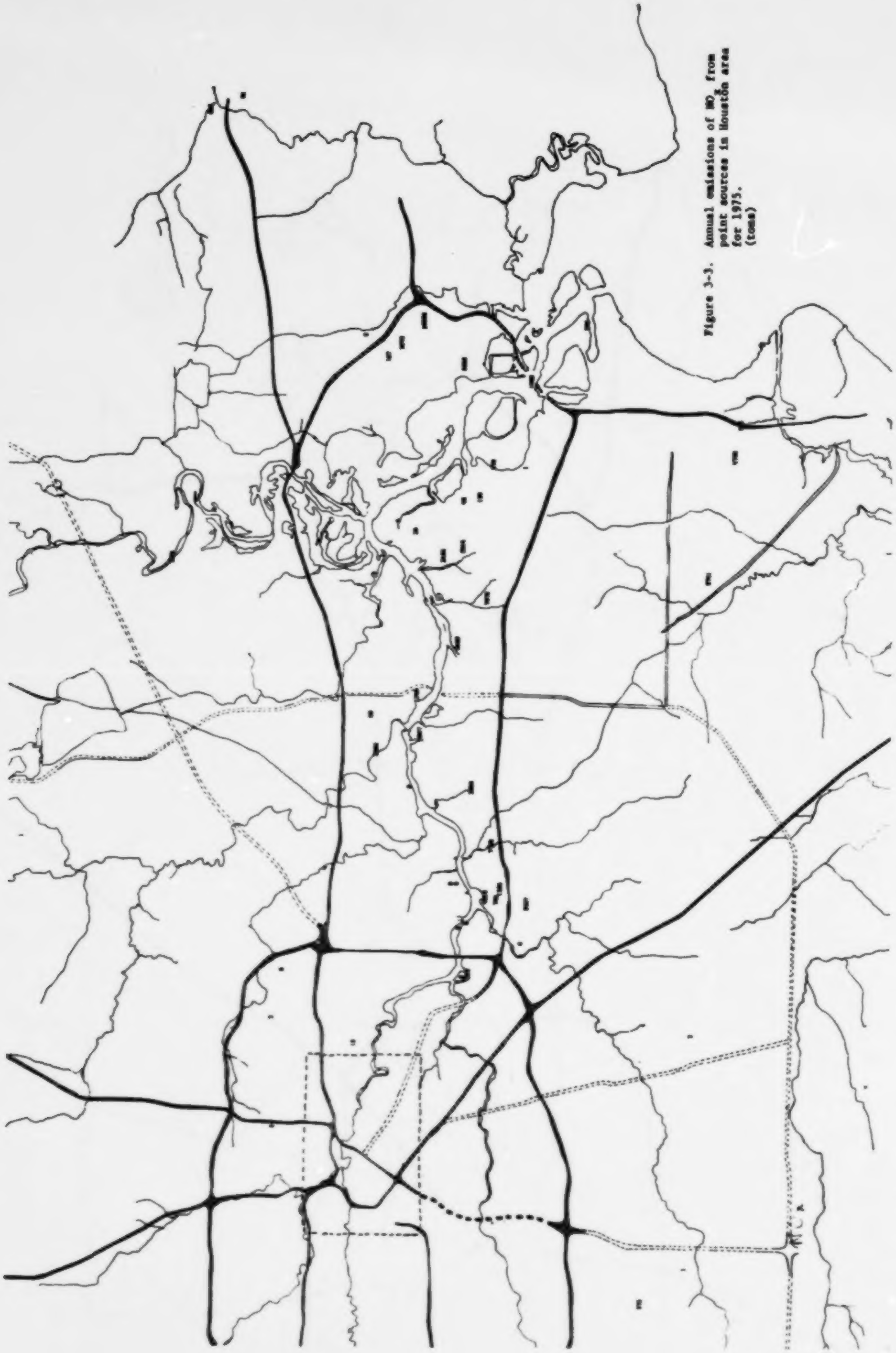


Figure 3-3. Annual emissions of NO_x from point sources in Houston area for 1975. (tons)

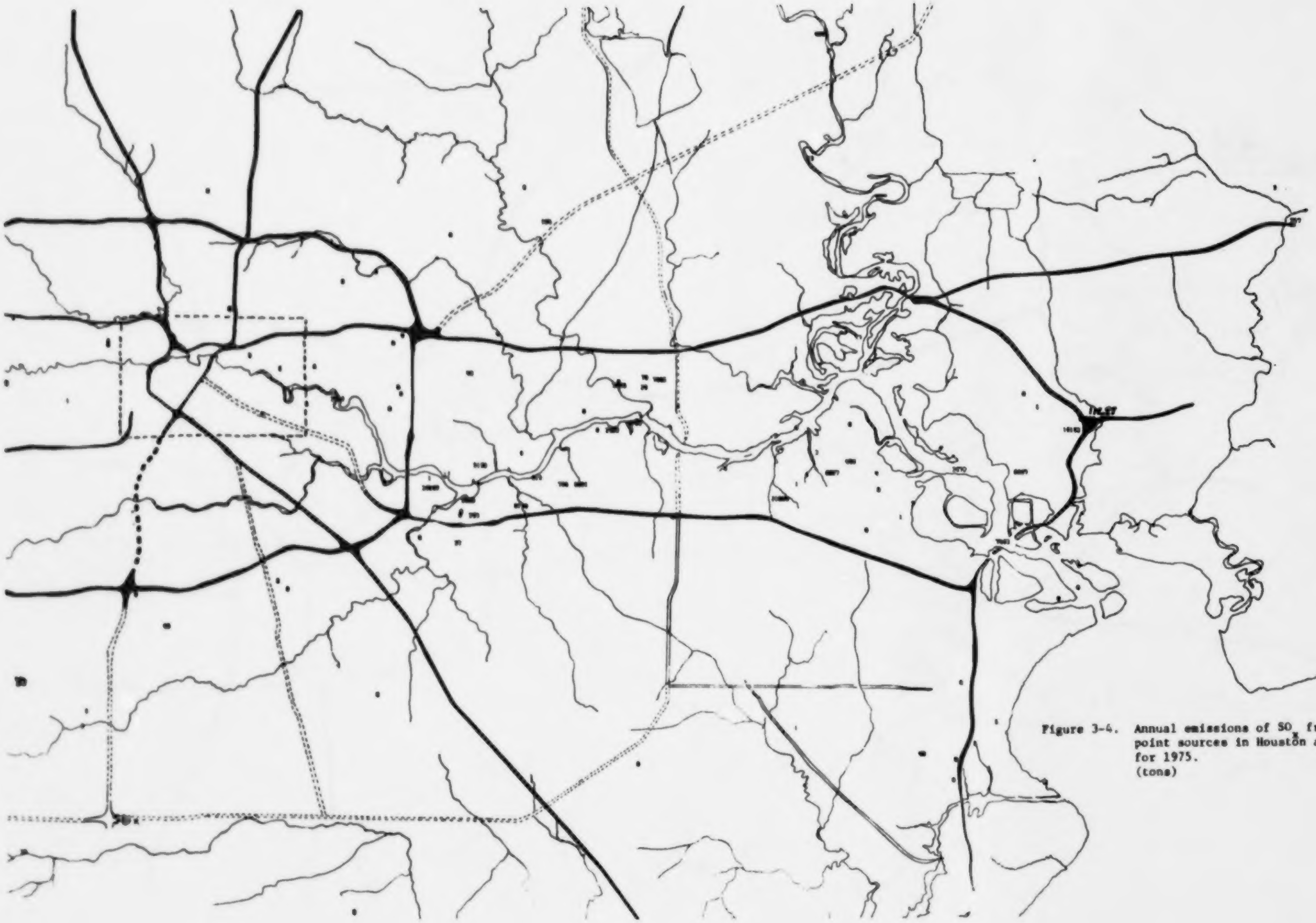


Figure 3-4. Annual emissions of SO_x from point sources in Houston area for 1975. (tons)

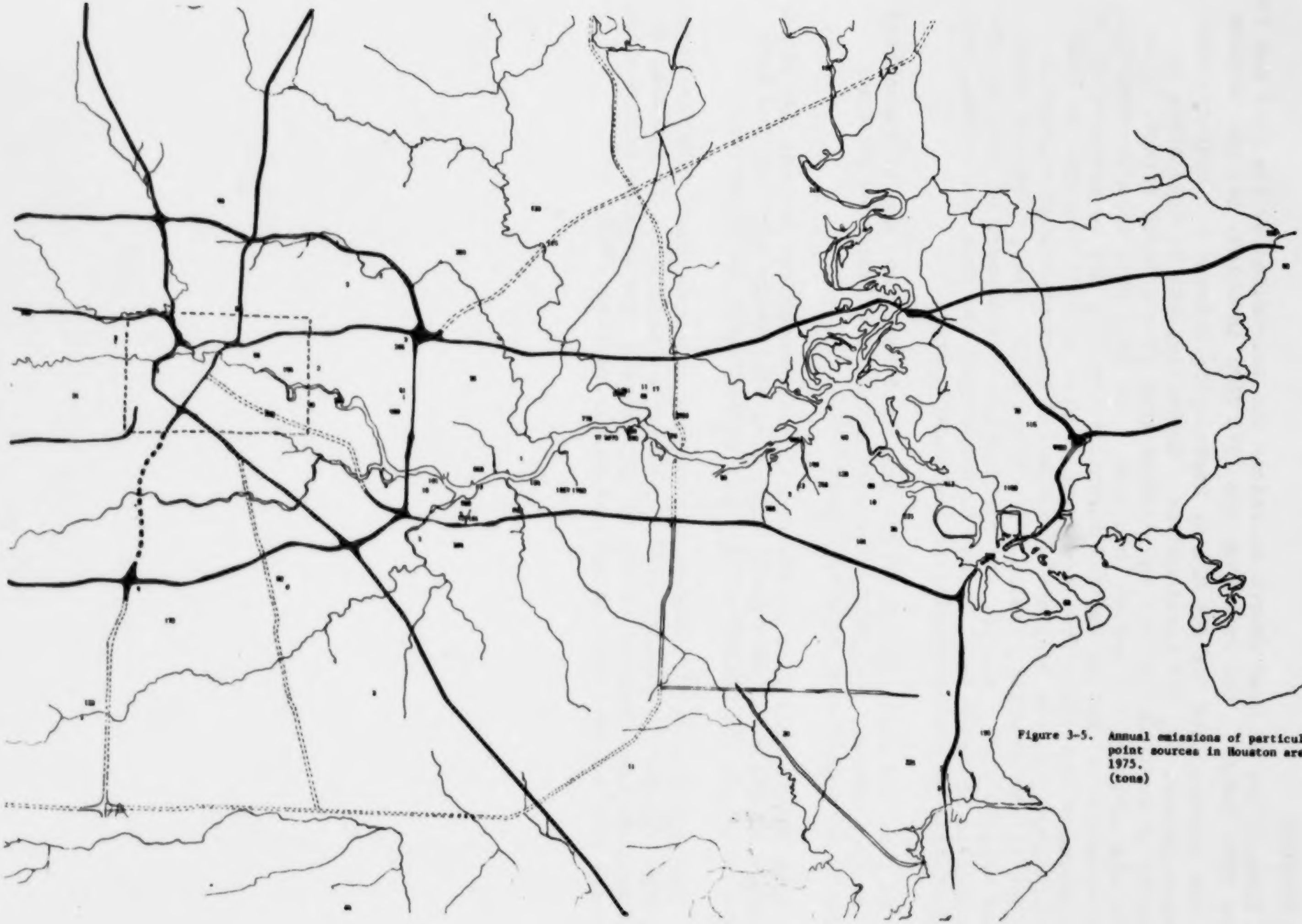


Figure 3-5. Annual emissions of particulates from point sources in Houston area for 1975. (tons)

Area Sources

Inventories of area source emissions are maintained by the TACB and the EPA in NEDS format. The data from the 1975 TACB inventory for the Houston area was computerized for the EPA by Engineering Science for hydrocarbons, nitrogen oxides, SO_x and particulates. Currently, SRI is developing an inventory of area sources for the Houston area in a gridded format. This may be available at the end of this year. The TACB will soon be submitting questionnaires so that an updated inventory for 1978 may be prepared in 1979. A breakdown of emissions from area type sources in 1975 prepared by TACB for each county in the Houston-Galveston and Beaumont-Orange regions is provided in the appendix, Tables A-1 through A-10. The pollutants inventoried were NO_x, SO_x, HC, CO, and particulates. A summary of this information is presented in Table 3-3. It may be noted that the area source emissions are dominated by transportation in the Houston area.

So that the distribution of the area type emissions may be visualized in a spacial manner, the totals for each county are indicated on a map of the Houston-Galveston area in Figure 3-6.

Area source emissions in the Houston-Galveston area account for about one-third of the total emissions (area plus stationary sources) for both carbon compounds and oxides of nitrogen as indicated in Table 3-4.

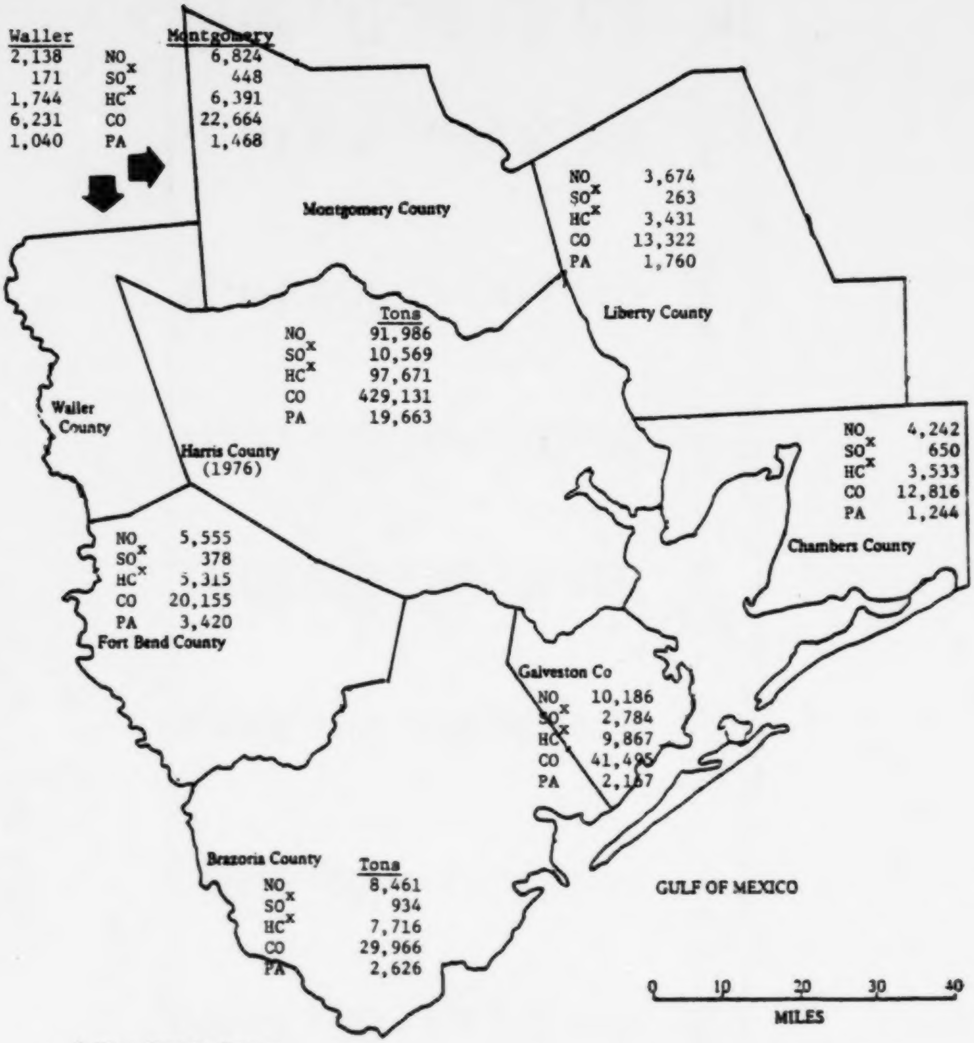
The area source SIP emissions inventory of non-methane volatile organic compounds for Harris County, 1977, is shown in Table 3-5. It is based on the 1975 inventory but updated by use of information from permits issued since then and with revised data on vehicle miles traveled. (VMT)

TABLE 3-3. 1975 AREA SOURCES EMISSIONS IN HOUSTON AND GALVESTON SMSA'S BY COUNTY

Emissions	COUNTY							Total SMSA
	Brazoria	Ft. Bend	Galveston	Harris*	Liberty	Montgomery	Waller	
Total Non-Methane Carbon Compounds	7716	5315	9867	97671	3431	6391	1744	132135
Transportation	6777	4686	8747	84880	2908	5562	1463	115023
Fuel Handling	682	503	737	8769	318	543	184	11736
Other	257	126	383	4023	205	286	97	5377
Total NO$_x$	8461	5555	10136	91986	3674	6824	2138	128773
Transportation	8157	5382	9748	86973	3570	6663	2088	122581
Other	304	173	388	5013	104	161	50	6193
Total SO$_x$	934	378	2784	10569	263	448	171	15547
Transportation	778	302	2551	7903	221	377	151	12283
Combustion	154	75	229	2625	41	70	18	3212
Other	2	1	4	42	1	1	2	53
Total Carbon Monoxide	29966	20155	41495	429131	13322	22664	6231	562964
Transportation	29586	19965	40931	422343	12404	21477	5939	552645
Combustion	355	179	527	6032	94	160	42	7389
Other	25	12	37	756	824	1026	249	2929
Total Particulates	2626	3420	2167	19663	1760	1468	1040	32144
Transportation	782	518	980	8314	338	603	194	11729
Unpaved/Paved Road	754	622	828	7565	424	644	258	11095
Combustion	174	85	259	2967	46	79	21	3631
Agriculture	904	2189	81	570	854	18	527	5143
Other	12	6	18	247	98	123	40	544

* Harris County figures are for 1976

Source: TACB


Waller
2,138 NO_x
171 SO_x
1,744 HC
6,231 CO
1,040 PA
Montgomery
6,824
448
6,391
22,664
1,468
Montgomery County
NO_x 3,674
SO_x 263
HC 3,431
CO 13,322
PA 1,760
Liberty County
Tons
NO_x 91,986
SO_x 10,569
HC 97,671
CO 429,131
PA 19,663
Waller County
Harris County (1976)
NO_x 4,242
SO_x 650
HC 3,533
CO 12,816
PA 1,244
Chambers County
NO_x 5,555
SO_x 378
HC 5,315
CO 20,155
PA 3,420
Fort Bend County
Galveston Co
NO_x 10,186
SO_x 2,784
HC 9,867
CO 41,495
PA 2,167
Brazoria County
Tons
NO_x 8,461
SO_x 934
HC 7,716
CO 29,966
PA 2,626
GULF OF MEXICO
0 10 20 30 40
MILES

* PA = Particulates

Figure 3-6. Annual emissions from area sources in 1975 for counties in Houston-Gavleston area.

TABLE 3-4. TOTAL ANNUAL EMISSIONS (NON-METHANE) FOR THE HOUSTON AND GALVESTON SMA

	Tons	% of Total
Total Carbon Compound Emissions	343078	--
Area	133975	39
Stationary	209103	61
Total NO_x Emissions	327094	--
Area	126885	39
Stationary (for HC sources only)	200209	61

Source: TACB 1975 Emissions Inventory

TABLE 3-5

AREA SOURCE
SIP EMISSIONS INVENTORY
NON-METHANE VOLATILE ORGANIC COMPOUNDS
(TONS/YR)

COUNTY Harris YEAR 1977

Fuel Combustion - Stationary	
Residential Fuel	
Natural Gas	238
Distillate Oil	34
Wood	404
Commercial/Industrial - Energy	
Natural Gas	113
Oil	147
Irrigation Pumps	
Natural Gas	0
Gasoline	0
Solid Waste - Commercial/Industrial Incineration	70
Transportation	
Gasoline	
Light Duty Vehicles	66,210
Light Duty Trucks	18,862
Heavy Duty Trucks	3,964
Motorcycles	3,975
Off-Highway	2,190
Diesel	
Heavy Duty Trucks	282
Off-Highway	558
Rail	638
Aircraft	
Military	754
Civil	97
Commercial	1,115
Vessels	
Gasoline	916
Diesel	232
Residual	179
Fuel Handling Evaporation	
Service Stations, Tank Loading	325
Service Stations, Vehicle Loading	4,467
Other Fuel Handling Evaporation	284
Miscellaneous	
● Cutback Asphalt Paving	2,489
Solvent Evaporation	
● Dry Cleaning	1,304
● Architectural & Miscellaneous Coating	1,425
Structural Fires	20
Forest Fires	55
TOTAL - AREA SOURCES	111,347

● (CTG ITEMS)

SECTION 4

MONITORING DATA

Ambient air monitoring first began in the Houston area in the 1960's Before 1970, both the Texas State Department of Health and the City of Houston were monitoring total suspended particulate (TSP), and a few other pollutants, such as total oxidants and sulfur dioxide. During the current decade, much more extensive monitoring of air pollution has taken place in the Houston area.

Monitoring site information and data summaries are presented in this section. Emphasis has been placed on information and data that are relevant to the Texas Gulf Coast Study.

SITE INFORMATION

The Houston area monitoring sites have been classified into four categories:

- continuous criteria-existing sites,
- continuous criteria - temporary sites,
- non-continuous criteria-existing sites, and
- non-continuous criteria-temporary sites.

Continuous criteria sites are sites for which most or all of the data is collected at periodic intervals of one hour or less (usually for hourly averages) 24 hours each day. Whereas, non-continuous criteria sites sample either for long time intervals (usually one day, as for Hi-Vols), or for intermittent instantaneous intervals (as for grab bag samples). The existing sites are sites which will more than likely be in operation during the next year (1979) and probably for a longer time span. Most of the temporary sites are no longer in operation. However, some of the temporary sites coincide with permanent existing sites. In these cases, certain parameters were monitored on a temporary basis, and are not presently monitored.

Continuous Criteria-Existing Sites

Separate one page detailed site descriptions are provided for eighteen existing continuous monitoring sites in the Texas Gulf Coast Study Area. All of these sites (except possibly the Beasley site) will be in operation through at least December 31, 1979. An additional site is scheduled to be added by the Texas Air Control Board, before the end of 1978, in the Seabrook area. This Seabrook site will have the same compliment of instruments as the Texas City site.

A map reference number is given in parentheses after each site location address. This number refers to the numbered location shown in Figures 4-1 and 4-2. Abbreviations for the parameters monitored are as follows:

O_3 - ozone
NO_x - oxides of nitrogen
NO - nitric oxide
THC - total hydrocarbons
CH_4 - methane
TS - total sulfur
SO_2 - sulfur dioxide
H_2S - hydrogen sulfide
FID - flame ionization detector
TSP - total suspended particulate (non-continuous)
Pb - lead (non-continuous)
$SO_4^=$ - sulfate (non-continuous)
NO_3^- - nitrate (non-continuous)
WS - wind speed
WD - wind direction
TEM - temperature
DP - dewpoint
SR - solar radiation
VIS - visibility
RAIN - rainfall

Following the list of site descriptions is a description of the calibration and quality assurance procedures used by several monitoring agencies. Additional abbreviations from this section are as follows:

NBKI - neutral buffered potassium iodide
NO_2 - nitrogen dioxide
NBS - National Bureau of Standards

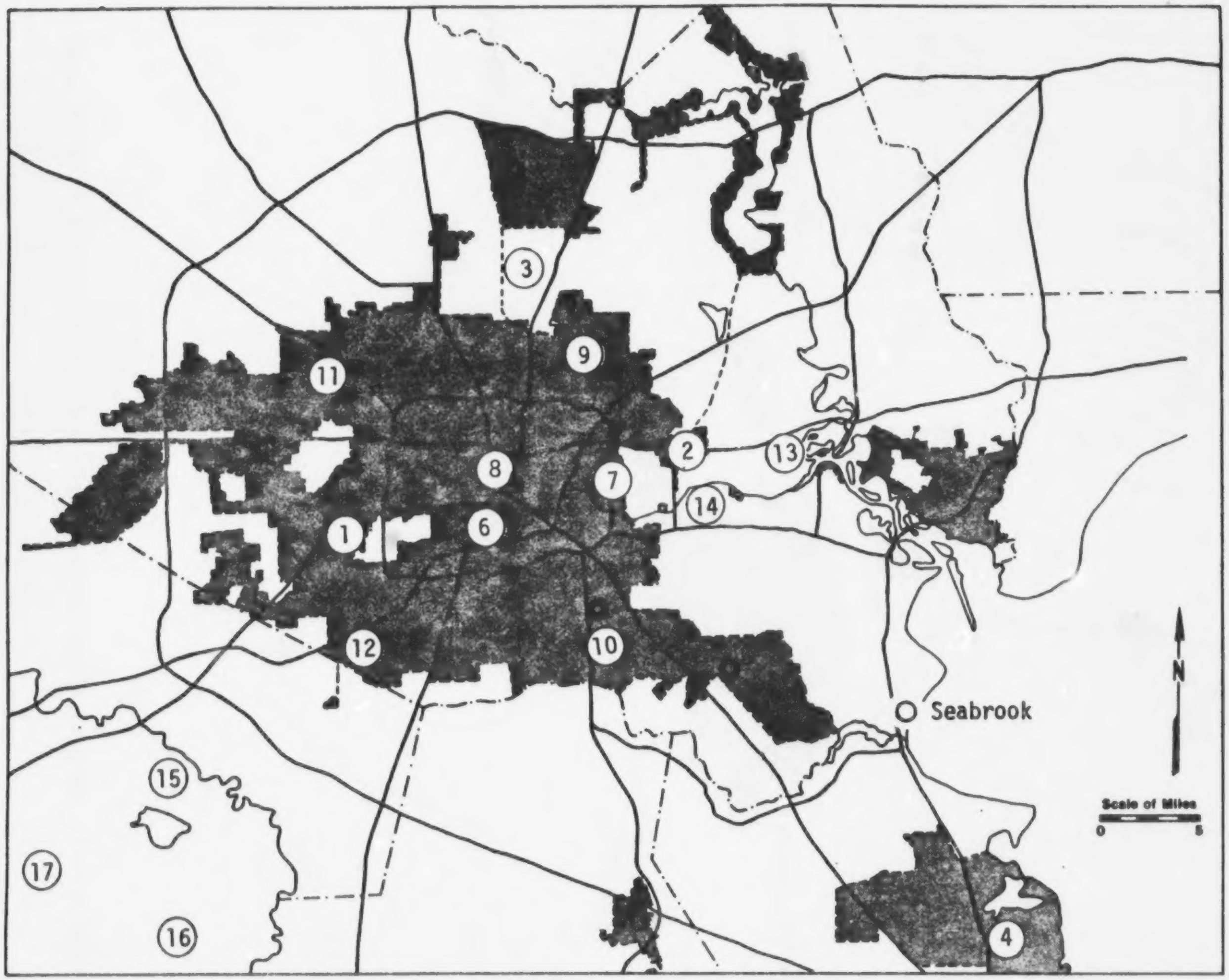

③
⑨
⑪
②
⑬
⑧
⑦
⑭
①
⑥
⑫
⑩
Seabrook
N
Scale of Miles
0
5
⑮
⑰
⑯
④

Figure 4-1. Existing continuous criteria sites in the Houston area.

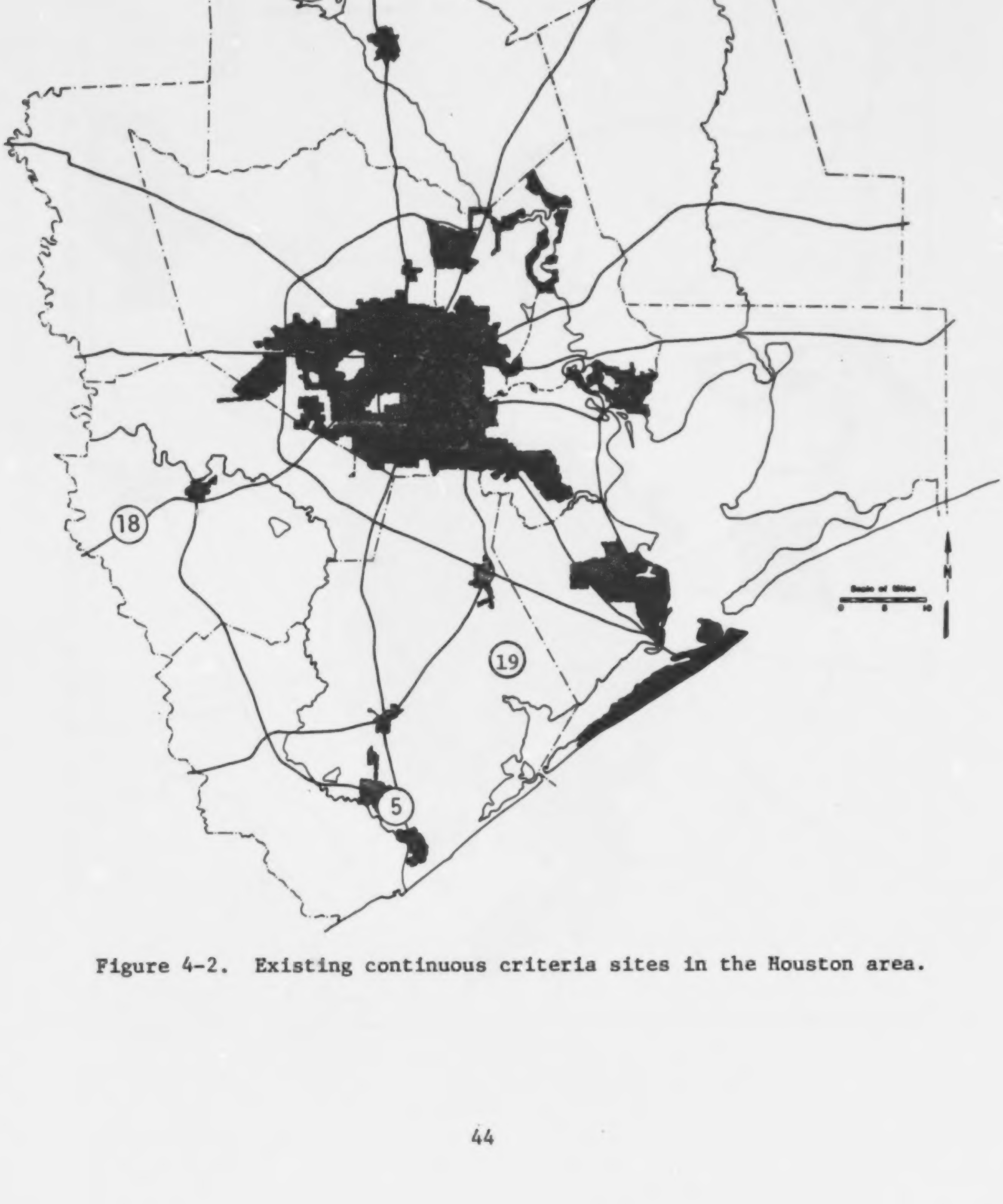

18
19
5
0
5
10
N

Figure 4-2. Existing continuous criteria sites in the Houston area.

SITE:	Hornwood
LOCATION:	6608 Hornwood, Houston (1) Latitude 29° 42' 35" Longitude 95° 30' 08" UTM Zone 15 257.923 E 3280.063 N
AGENCY:	U.S. Environmental Protection Agency
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	O_3 - Bendix
EXPOSURE AND SURROUNDINGS:	Commercial and residential areas nearby. Southwest Freeway (U.S. 59) located a few blocks west, downtown about 9 miles east-northeast.
LENGTH OF STATION RECORD:	June 15, 1977 to present.

SITE:	Houston East (Mae Drive) Saroad ID #2560034F01
LOCATION:	1224 Mae Drive (2) Latitude 29° 46' 03" N Longitude 95° 13' 14" W UTM Zone 15 285.303 E 3295.162 N
AGENCY:	Texas Air Control Board
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	O_3 - McMillan 1100 Ozone Monitor (Chemiluminescent) CO, CH_4, THC - Bendix 8200 Environmental Gas Chromatograph (FID) NO, NO_x - TECO (Chemiluminescent) TS, SO, H_2S - Bendix 8301 Analyzer (Flame Photometric) TSP, Pb, $SO_4^{=}$, NO_3^- - Hi-Vol WS, WD, TEM - Climet DP - EG&G SR - Eppley VIS - MRI Nephelometer
EXPOSURE AND SURROUNDINGS:	Air intake - 22 feet Meteorological gear - 19 feet Level terrain at southest corner of Harris Elementary School. Area immediately surrounding site is mostly residential with a few small commercial businesses. Interstate Highway 10 is about 1½ blocks north of site. Ship channel industrial area one to five miles southwest, south, and southeast, with oil refineries, petroleum processing, plants, chemical processing plants, a paper mill, and a steel mill.
LENGTH OF STATION RECORD:	April 12, 1973 through present.

SITE:	Aldine SAROAD ID #2330024F01
LOCATION:	Aldine Mail Road, Harris County (3) Latitude 29° 54' 02" N Longitude 95° 21' 41" W UTM Zone 15 275.473 E 3310.112 N
AGENCY:	Texas Air Control Board
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	O_3 - McMillan 1100 Ozone Monitor (Chemiluminescent) CO, CH_4, THC - Bencix 8200 Environmental Gas Chromatograph (FID) NO, NO_x - TECO (Chemiluminescent) TS, SO_2, H_2S - Bendix 8301 Analyzer (Flame Photometric) TSP, Pb, $SO_4^{=}$, NO_3^{-} - Hi-Vol WS, WD, TEM - Climet SR - Eppley VIS - MRI Nephelometer
EXPOSURE AND SURROUNDINGS:	Air intake - 22 feet Meteorological gear - 19 feet Flat terrain on grounds of Hambrick Junior High School, 100 yards southwest of the junior high school and 200 yards east of McArthur High School. No nearby heavy industrial pollutant sources. Eastex Freeway (U.S. 59) which runs north-northeast is one mile to the east.
LENGTH OF STATION RECORD:	February 1, 1974 through present.

SITE: Texas City
SAROAD ID #5170002F01

LOCATION: 2702 13th Avenue North, Texas City (4)
Latitude 29° 23' 55" N
Longitude 94° 56' 00" W
UTM Zone 15
312.398 E
3253.773 N

AGENCY: Texas Air Control Board

PARAMETERS MONITORED-TYPE OF INSTRUMENTATION:
O_3 - McMillan 1100 Ozone Monitor (Chemiluminescent)
CO, CH_4, THC - Bendix 8200 Environmental Gas Chromatograph (FID)
NO, NO_x - TECO (Chemiluminescent)
TS, SO_2, H_2S - Bendix 8301 Analyzer (Flame Photometric)
TSP, Pb, $SO_4^{=}$, NO_3^{-} = Hi-Vol
WS, WD, TEM - Climet

EXPOSURE AND SURROUNDINGS:
Air intake - 22 feet
Meteorological gear - 19 feet
Located in grass covered parking area on south side of Robinson Municipal Stadium. Area within mile of site is mostly residential and small commercial business. Palmer Highway is 2 blocks south and Highway 146 is one west. Large industrial complex from about 2 miles southeast to 2 miles southwest of site, with several oil refineries, a non-ferrous smelter, and several petrochemical complexes.

LENGTH OF STATION RECORD: June 6, 1974 through present.

SITE:	Clute SAROAD ID #0950003F01
LOCATION:	Cobb Field, North Commerce Street, Clute (5) Latitude 29° 00' 39" N Longitude 95° 23' 52" W UTM Zone 15 266.440 E 3211.622 N
AGENCY:	Texas Air Control Board
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	O_3 - McMillan 1100 Ozone Monitor (Chemiluminescent) CO, CH_4, THC - Bendix 8200 Environmental Gas Chromatograph (FID) NO, NO_x - TECO (Chemiluminescent) TS, SO_2, H_2S - Bendix 8301 Analyzer (Flame Photometric) TSP, Pb, $SO_4^=$, NO_3^- = Hi-Vol WS, WD, TEM - Climet
EXPOSURE AND SURROUNDINGS:	Air intake - 22 feet Meteorological gear - 19 feet Generally smooth terrain at the entrance to Cobb Field. Grassy open areas to south, west, and east, with residential areas to east and north. Large petrochemical complex from one mile south to five miles southeast, including a chemical plant.
LENGTH OF STATION RECORD:	June 25, 1974 to present.

SITE:	MacGregor SAROAD ID #2550007H
LOCATION:	1115 North MacGregor, Houston (6) Latitude 29° 43' 30" Longitude 95° 23' 32" UTM Zone 15 268.603 E 3290.782 N
AGENCY:	City of Houston Health Department
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	* O_3 - McMillan 1100 Ozone Analyzer (Chemiluminescent) * NO, NO_x - MEC 1200 Analyzer (Chemiluminescent) WS, WD - Teledyne Geotech
EXPOSURE AND SURROUNDINGS:	Air intake - 50 feet Meteorological gear - 50 feet Located on the third floor of the Health Department Building. Downtown Houston is approximately 4 miles northeast, Loop 610 is 2 miles south, and the Southwest Freeway is 2 miles north. The Texas Medical Center is adjacent to the Health Department. Mostly residential and business areas nearby. Ship channel industrial area over 10 miles east.
LENGTH OF STATION RECORD:	1974 through present with present configuration. 1971 to 1974 with alternate configuration.

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*Removed during 1978.

SITE:	Clinton SAROAD ID#2560035H
LOCATION:	9525 Clinton, Drive, Houston (7) Latitude 29° 44' 00" N Longitude 95° 15' 00" W UTM Zone 15 282.382 E 3291.429 N
AGENCY:	City of Houston Health Department
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	O_3 - McMillan 1100 Ozone Monitor (Chemiluminescent) CO, CH_4, THC - Beckman 6800 Gas Chromatograph (FID) SO_2 - Tracor 270 HA Gas Chromatograph (Flame Photometric) * NO, NO_x - MEC 1200 Analyzer (Chemiluminescent) TSP - Hi-Vol WS, WD, TEM - RM Young
EXPOSURE AND SURROUNDINGS:	Air intake - 15 feet Meteorological gear - 18 feet Located less than one-half a mile north of the Houston ship channel, between industrial areas to the south and residential and commercial areas to the north. The land is smooth with no distinguishing terrain features. A refinery lies across Clinton Drive to the southeast.
LENGTH OF STATION RECORD:	1974 through present with present configuration. 1971 to 1974 with alternate configuration.

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* Removed during 1978.

SITE:	Crawford SAROAD ID#2560037H
LOCATION:	1307 Crawford, Houston (8) Latitude 29° 45' 07" Longitude 95° 21' 41" UTM Zone 15 271.648 E 3293.708 N
AGENCY:	City of Houston Health Department
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	O_3 - McMillan 1100 Ozone Monitor (Chemiluminescent) CO, CH_4, THC - Beckman 6800 Gas Chromatographs (FID) * NO, NO_x - MEC 1200 Analyzer (Chemiluminescent) TSP - Hi-Vol
EXPOSURE AND SURROUNDINGS:	Air intake - 15 feet Meteorological gear - 18 feet Located across the street from a fire station building. Commercial and residential areas nearby. Downtown business district one-half mile northwest, ship channel industrial area starts about two miles east and extends eastward. Major freeways exist in all directions at distances less than a mile.
LENGTH OF STATION RECORD:	1974 through present with present configuration. 1971 to 1974 with alternate configuration.

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* Removed during 1978

SITE:	Parkhurst SAROAD ID #2560038H
LOCATION:	8314 Parkhurst, Houston (9) Latitude 29° 50' 15" Longitude 95° 17' 11" UTM Zone 15 270.909 E 3303.046 N
AGENCY:	City of Houston Health Department
PARAMETERS MONITORED - TYPE OF INSTRUMENTS:	O_3 - McMillan 1100 Ozone Monitor (Chemiluminescent) CO, CH_4, THC - Beckman 6800 Gas Chromatograph (FID) * NO, NO_x - MEC 1200 Analyzer (Chemiluminescent) TSP - Hi-Vol RAIN - MRI
EXPOSURE AND SURROUNDINGS:	Air intake - 15 feet Meteorological gear - 18 feet Generally smooth terrain with some trees. Large water tanks to southeast. Mostly residential areas nearby. Loop 610 is 2½ miles south, Eastex Freeway (U.S. 59) is 3 miles west. Houston ship channel industry is over 5 miles to the south and southeast.
LENGTH OF STATION RECORD:	1974 to present.

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* Removed during 1978.

SITE:
Fuqua
SAROAD ID #2560039H

LOCATION:
7834 Fuqua, Houston (10)
Latitude 29° 36' 45" N
Longitude 95° 16' 45" W
UTM Zone 15
279.296 E
3278.089 N

AGENCY:
City of Houston Health Department

PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:
O_3 - McMillan 1100 Ozone Monitor (Chemiluminescent)
* NO, NO_x - MEC 1200 Analyzer (Chemiluminescent)
TS, H_2S, SO_2 - Tracor 270 HA Gas Chromatograph (Flame Photometric)
THC, CH_4, CO - Beckman 6800 Gas Chromatograph
TSP - Hi-Vol

EXPOSURE AND SURROUNDINGS:
Air intake - 15 feet
Meteorological gear - 18 feet
Generally smooth terrain, water tank 15 to 20 feet high located 50 feet northwest. Ship channel industrial area over 8 miles northeast, Bayport industrial area about 12 miles east.

LENGTH OF STATION RECORD:
1974 through present.

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* Removed during 1978

SITE:	Lang SAROAD ID #2560011 H
LOCATION:	4420 Bingle, Houston (11) Latitude 29° 49' 12" Longitude 95° 29' 02" UTM Zone 15 259.960 E 3301. 249 N
AGENCY:	City of Houston Health Department
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	O_3 - McMillan 1100 Ozone Monitor (Chemiluminescent) WS, WD, TEM - Climet
EXPOSURE AND SURROUNDINGS:	Air intake - 17 feet Meteorological gear - 18 feet Trees within 25 yards on smooth terrain. Residential and commercial areas nearby. Highway 290 is one-half mile north, downtown is about 8 miles southeast.
LENGTH OF STATION RECORD:	1976 to present.

SITE:	Croquet SAROAD ID #unassigned
LOCATION:	13826 Croquet at corner of Darlinghurst, Houston (12) Latitude 29° 37' 25" Longitude 95° 28' 26" UTM Zone 15 260.452 E 3279.548 N
AGENCY:	City of Houston Health Department
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION	O_3 - McMillan 1100 Ozone Analyzer (Chemiluminescent) WS, WD, TEM - Climet RAIN - MRI
EXPOSURE AND SURROUNDINGS:	Flat terrain in mostly residential and commercial area. Highway 90 is one mile northwest, downtown is about 11 miles northeast, and the ship channel industrial area is about 15 miles east-northeast.
LENGTH OF STATION RECORD:	July 1978 to present.

SITE:	Channelview (Trailer 008) Private
LOCATION:	DeZavalla between Elsbeth and Lakside, Harris County (13) Latitude 29° 46' 33" Longitude 95° 05' 48" UTM Zone 15 296.524 E 3294.738 N
AGENCY:	Houston Lighting and Power (operated by Radian Corporation)
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	NO, NO_x - Columbia Scientific Model 1600 (Chemiluminescent) SO_2 - Meloy Model SA-185-2A (Flame Photometric) TSP - Hi-Vol WS - Weather Measure W 103/3L (Cup Anemometer) WD - Weather Measure W 104-2 (Light Weight Vane) TEM - Yellow Springs Instrument 44018 DP - Climatronics DP-10
EXPOSURE AND SURROUNDINGS:	Air intake - 15 feet Meteorological gear - 25 feet Generally flat terrain in residential area adjacent to ship channel industrial area. Numerous trees nearby. Ship channel lies from WSW to S to ESE, as close as one mile.
LENGTH OF RECORD:	March 1978 to present.

SITE:	North Pasadena (Trailer 011) Private
LOCATION:	Ethyl Road about 3/4 mile north of Highway 225, Pasadena (14) Latitude 29° 43' 53" Longitude 95° 09' 55" UTM Zone 15 290.571 E 3289.714 N
AGENCY:	Houston Lighting and Power (operated by Radian Corporation)
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	NO, NO_x - Columbia Scientific Model 1600 (Chemiluminescent) SO_2 - Meloy Model SA-185-2A (Flame Photometric) TSP - Hi-Vol WS - Weather Measure W 103/3L (Cup Anemometer) WD - Weather Measure W 104-2 (Light Weight Vane) TEM - Yellow Springs Instrument 44018 DP - Climatronics DP-10
EXPOSURE AND SURROUNDINGS:	Air intake - 15 feet Meteorological gear - 25 feet Located just west of a power substation on flat terrain. Ship channel industry from west through north to east, as close as one mile.
LENGTH OF STATION RECORD:	March 1978 to present.

SITE:	North Parish (Trailer 015) Private
LOCATION:	Insurance Road, 8/10 mile north of FM 2759, Fort Bend County (15) Latitude 29° 32' 14" Longitude 95° 38' 08" UTM Zone 15 244.595 E 3270.429
AGENCY:	Houston Lighting and Power (operated by Radian Corporation)
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	NO, NO_x - Columbia Scientific Model 1600 (Chemiluminescent) SO_2 - Meloy Model SA-185-2A (Flame Photometric) TSP - Hi-Vol WS - Weather Measure W 103/3L (Cup Anemometer) WD - Weather Measure W 104-2 (Light Weight Vane) TEM - Yellow Springs Instrument 44018 DP - Climatronics DP-10
EXPOSURE AND SURROUNDINGS:	Air intake - 15 feet Meteorological gear - 25 feet Flat terrain in rural area with 30 to 40 foot trees nearby, surrounding the site. Mostly forest and farmland in the area. W. A. Parish Generating Station about 4 miles south.
LENGTH OF RECORD:	January 1978 to present.

SITE:	South Parish (Trailer (017) Private
LOCATION:	Rawlings Road at intersection of Peters Road, Fort Bend County (16) Latitude 29° 24' 54" N Longitude 95° 39' 10" W UTM Zone 15 242.875 E 3256.875 N
AGENCY:	Houston Lighting and Power (operated by Radian Corporation)
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	NO, NO_x - Columbia Scientific Model 1600 (Chemiluminescent) SO_2 - Meloy Model SA-185-2A (Flame Photometric) TSP - Hi-Vol WS - Weather Measure W 103/3L (Cup Anemometer) WD - Weather Measure W 104-2 (Light Weight Vane) TEM - Yellow Springs Instrument 44018 DP - Climatronics DP-10 SR - Eppley Precision Spectral Pyranometer Model PSP RAIN - Weather Measure Model P501-1 (Tipping Bucket)
EXPOSURE AND SURROUNDINGS:	Air intake - 15 feet Meteorological gear - 25 feet Flat rural farm area. A few trees with house about 70 yards east. W. A. Parish Generating Station about 4 miles north.
LENGTH OF STATION RECORD:	January 1978 through present.

SITE:	West Parish Private
LOCATION:	4½ miles south at FM 762, on FM 2977, then ½ mile southeast, Fort Bend County (17) Latitude 29° 28' 30" N Longitude 95° 47' 23" W UTM Zone 15 232.875 E 3264.875 N
AGENCY:	Houston Lighting and Power (operated by Radian Corporation)
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	NO, NO_x - Columbia Scientific Model 1600 (Chemiluminescent) SO_2 - Meloy Model SA-185-2A (Flame Photometric) TSP - Hi-Vol WS - Weather Measure W 103/3L (Cup Anemometer) WD - Weather Measure W 104-2 (Light Weight Vane) TEM - Yellow Springs Instrument 44018 DP - Climatronics DP-10
EXPOSURE AND SURROUNDINGS:	Air intake - 15 feet Meteorological gear - 25 feet Flat rural farm land. Several oil storage tanks about ½ mile southeast, W. A. Parish Generating Station about 7½ miles east.
LENGTH OF STATION RECORD:	March 1978 to present.

SITE:	Beasley Private
LOCATION	Beasley, Forth Bend County (18) Latitude 29° 31' 15" N Longitude 95° 55' 32" W UTM Zone 15 216.421 E 3269.082 N
AGENCY:	Monsanto
PARAMETERS MONITORED - TYPE OF INSTRUMENTATION:	O_3
EXPOSURE AND SURROUNDINGS:	Rural area about 36 miles southwest of downtown Houston.

SITE:	Chocolate Bayou SAROAD ID #0540001
LOCATION:	5½ miles southeast from State Highway 35 on County Road 203, or four miles southeast of Liverpool, and 12 miles south of Alvin, Brazoria County (19) Latitude 29° 28' 47" N Longitude 95° 47' 23" W UTM Zone 15 282.875 E 3238.395 N
AGENCY:	University of Texas, Bureau of Economic Geology
PARAMTERS MONITORED - TYPE OF INSTRUMENTATION:	SO_2 - Meloy Model SA185-2A (Flame Photometric) H_2S - Meloy Model SA185-2 (Flame Photometric with SO_x scrubber) CH_4 - Bendix Model 8200 Gas Chromatograph (FID) TSP - Hi-Vol
EXPOSURE AND SURROUNDINGS:	Air intake - 15 feet Flat rice fields nearby. Chemical plant about 1 mile east to southeast.
LENGTH OF RECORD:	March 1978 to present.

Agency Calibration and Quality Assurance Procedures

Texas Air Control Board:
Monthly Calibration
O_3 - NBKI procedure using MEC 1000 ozone generator
NO_x - NO_2 permeation tube checked with wet chemistry, NO cylinder referenced to NBS
TS, SO_2, H_2S - SO_2 permeation tube checked with wet chemistry
THC, CH_4, CO - cylinder of CH /CO mixture referenced to NBS

Monthly output checks are made on permeation tubes with wet chemical methods by an Austin based audit team - data is deleted where a 20% or more drift is observed. A five point linearity check is performed on all analyzers quarterly. Laboratory audits are conducted twice yearly in Austin. Zero/span checks are made 3 days per week.

City of Houston:
Calibration every 45 days or sooner depending on daily zero/span results.
O_3 - NBKI procedure
NO_x - NBS referenced cylinder of NO
THC, CH_4, CO - NBX referenced gas cylinder every 45 days
TS, SO_2, H_2S - SO_2 permeation tube

Daily zero/span check
O_3 - with MEC 1000 ozone generator
NO_x - with NO_2 permeation tube
THC, CH_4, CO - with NBS referenced gas cylinder
SO_2 - with SO_2 permeation tube

Radian Corporation:
Monthly multi-point calibrations on each analyzer
Daily automatic calibration by computer
NO_x - NBS referenced bottled NO span gas
SO_2 - SO_2 permeation tube

Permeation tube oven temperatures are checked monthly. All gas and dilution air flows in calibration system are checked quarterly, and all instrument flow rates are checked monthly or whenever a problem is suspected. Quality assurance audits are performed quarterly on all instruments. Hi-vols are audited quarterly. Audit and calibration control limits for data validation are ± 20% for SO_2 and NO_x.

Continuous Criteria - Temporary Sites

Several air pollution studies in the Houston area have deployed continuous criteria monitoring sites, for periods up to three years, which are no longer in operation. These studies are described in Table 4-1, and more detailed descriptions of the monitoring sites from the more recent studies are provided in Table 4-2. Locations of the monitoring sites described in Table 4-2 are shown in Figures 4-3 and 4-4.

TABLE 4-1. HOUSTON AIR QUALITY STUDIES WITH TEMPORARY CONTINUOUS CRITERIA MONITORING

Agency	Study Description	Period of Study
EPA	Summer Ozone Study - continuous O_3 measurements at one site in Houston	Summer 1971
TSDH	Short-Term Ambient Air Quality Study - Continuous measurements of O_3	1972
NASA	Respirable Particulate Monitoring with Remote Sensors, by University of Texas Health Science Center at Houston - measurement of atmospheric aerosol characteristics in the respirable range from aircraft or satellite	July 1, 1971 - October 31, 1973
UTPH	Simultaneous Total Oxidant and Chemiluminescent Ozone Measurements in Ambient Air-oxidant and ozone measurements in Houston	May 1972 - December 1973
EPA	Detailed Hydrocarbons - measured by gas chromatograph, 21 samples collected and analyzed for ratios of certain hydrocarbons to acetylene at several sites	September 1, 1973; January 20, 1974; April 2, 1974
EPA	Detailed light hydrocarbons, by Washington State University - C_1 - C_5 hydrocarbons, NMHC, NO_x, and O_3 measured at ground, also aircraft O_3 measurements	October 8-19, 1973
EPA	Houston Urban Plume Study by University of Texas at Austin - aircraft measurements of O_3, NO, NO_2, HC, CO, SO_2, particle size distribution, particle filter samples, condensation nuclei, BSCAT, temperature, relative	July 15-24, 1974

(continued)

TABLE 4-1 (continued). HOUSTON AIR QUALITY STUDIES WITH TEMPORARY CONTINUOUS CRITERIA MONITORING

Agency	Study Description	Period of Study
	humidity, air speed, altitude, turbulence, and hourly pilot balloon wind soundings at 6 sites	
UH	Urban and Industrial Air Pollution in Houston Texas - I. Hydrocarbons - detailed hydrocarbons measurements	July 1973 and July-August 1974
EPA	Study of the Formation and Transport of Ambient Oxidants in the Western Gulf Coast and North-Central and Northeast Regions of the United States, by Research Triangle Institute - aircraft measurements of O_3, NO_x	July 1 - October 1, 1975
EPA	Measurement of Light Hydrocarbons and Studies of Oxidant Transport Beyond Urban Areas, Houston Study, by Washington State University - ground and aircraft measurements, including O_3, NO_x, PAN, CH_4, CO, individual HC (C_2-C_{10}), halocarbons, condensation nuclei and visual distance, plus numerous meterological parameters	July 1976
HCC	Houston Area Oxidants Study (HAOS) - extensive pollutant monitoring, with emphasis on photochemical oxidant pollutants, and haze causing pollutants	1975-1977
EPA	Houston Air Pollution Study (HAPS), stationary and mobile monitoring (trailers, vans, and aircraft) numerous pollutants, including O_3, SO_2, NO_x, CO, detailed HC, freon, detailed aerosols, vertical temperature and wind, and other meteorological measurements	September-October 1978

(continued)

TABLE 4-1 (continued). HOUSTON AIR QUALITY STUDIES WITH TEMPORARY CONTINUOUS CRITERIA MONITORING

Abbreviations:

EPA - U. S. Environmental Protection Agency
HCC - Houston Chamber of Commerce
NASA - National Aeronautics and Space Administration
TACB - Texas Air Control Board
TSDH - Texas State Department of Health
UH - University of Houston
UTPH - University of Texas, School of Public Health

TABLE 4-2. TEMPORARY CONTINUOUS CRITERIA MONITORING SITES

Agency	Location	Parameters Monitored	Duration
HLP	Nine sites ** (1-9)	NO_x, SO_2, TSP, WS, WD, TEM, RH (SR, RAIN at 3 of the sites)	January 1 - December 31, 1975
HLP	Three sites ** (10-12)	NO_x, SO_2, TSP, WS, WD, TEM, RH, (SR, RAIN at 1 site)	January 1, 1975 - December 31, 1977
WSU	Lang, Houston (13)	O_3, NO_x, NO_2, NO, CH_4, CO, THC, PAN, halocarbons, detailed HC, WS, WD, DP, TEM, SR, acoustic sounder, piballs	July 1-31, 1976
Dow Chemical	Freeport, Barzoria County (14)	O_3, NO_x, NMHC, CO, SO_2, WS, WD	June 15-October 15, 1977
Radian	10,000 block Jackrabbit Rd., Harris County (10)	O_3, UVR	June 15-October 15, 1977
Rockwell	Chemistry Bldg., Prairie View AM, Waller County (15)	O_3, NO_x	June 15-October 15, 1977
Rockwell	Offshore platform 2968 (16)	O_3	June 15 - October 15, 1977
Rockwell	Aldine, Harris County (17)	Oxidants, PAN	June 15-October 15, 1977
Rockwell	Crawford, Houston (18)	Oxidants, PAN	June 15-October 15, 1977
Rockwell	Fuqua, Houston (19)	Oxidants, PAN	June 15-October 15, 1977

(continued)

TABLE 4-2 (continued). TEMPORARY CONTINUOUS CRITERIA MONITORING SITES

Agency	Location	Parameters Monitored	Duration
Shell Oil	Westhollow, Highway 6 333 South, Harris County (20)	O_3, NO_x, NMHC, CO, SO_2, PAN, WS, WD	June 15-October 15, 1977
Celanese	Bayport, Bay Area Blvd and Red Bluff, Harris County (21)	O_3, NO_x, NMHC	July 1-October 15, 1977
Gulf Chemical	IH 10 near Sjolander Rd., Harris County (23)	O_3	July 1-October 15, 1977
GM	1922 Hartwick, Houston (24)	O_3, NO_x, NMHC, CO, SO_2, PAN, oxidants, WS, WD, UVR, light scattering	July 15-September 15, 1977
Radian	Aldine, Harris County (17)	Aldehydes	August 1-October 1, 1977

Agency Abbreviations:

GM - General Motors
HLP - Houston Lighting and Power
WSU - Washington State University
EPA - U. S. Environmental Protection Agency
HCC - Houston Chamber of Commerce
NASA - National Aeronautics and Space Administration
TACB - Texas Air Control Board
TSDH - Texas State Department of Health
UH - University of Houston
UTPH - University of Texas, School of Public Health

Parameter Abbreviations:

NMHC - non-methan hydrocarbons
PAN - peroxyacetyl nitrate

Parameter Abbreviations (continued):

RH - relative humidity
UVR - ultraviolet radiation

** HLP Site Locations:

Intersection of Rawlings and Peters Road (South Parish), Fort Bend County (1)

Insurance Road, 8/10 mile north of FM 2759 (North Parish), Fort Bend County (2)

11800 block off Highway 90 South, Harris County (3)

TABLE 4-2 (continued). TEMPORARY CONTINUOUS CRITERIA MONITORING SITES.

** HLP Site Locations (continued):

Intersection of Crosby-Babers Hill Road and Holy Road, Harris County (4)

Intersection of Kansas and East A Streets, La Porte (5)

1100 block of FM 517, Galveston County (6)

Intersection of Cedar Bayou Bayshore Road and McKinney, Calhoun County (7)

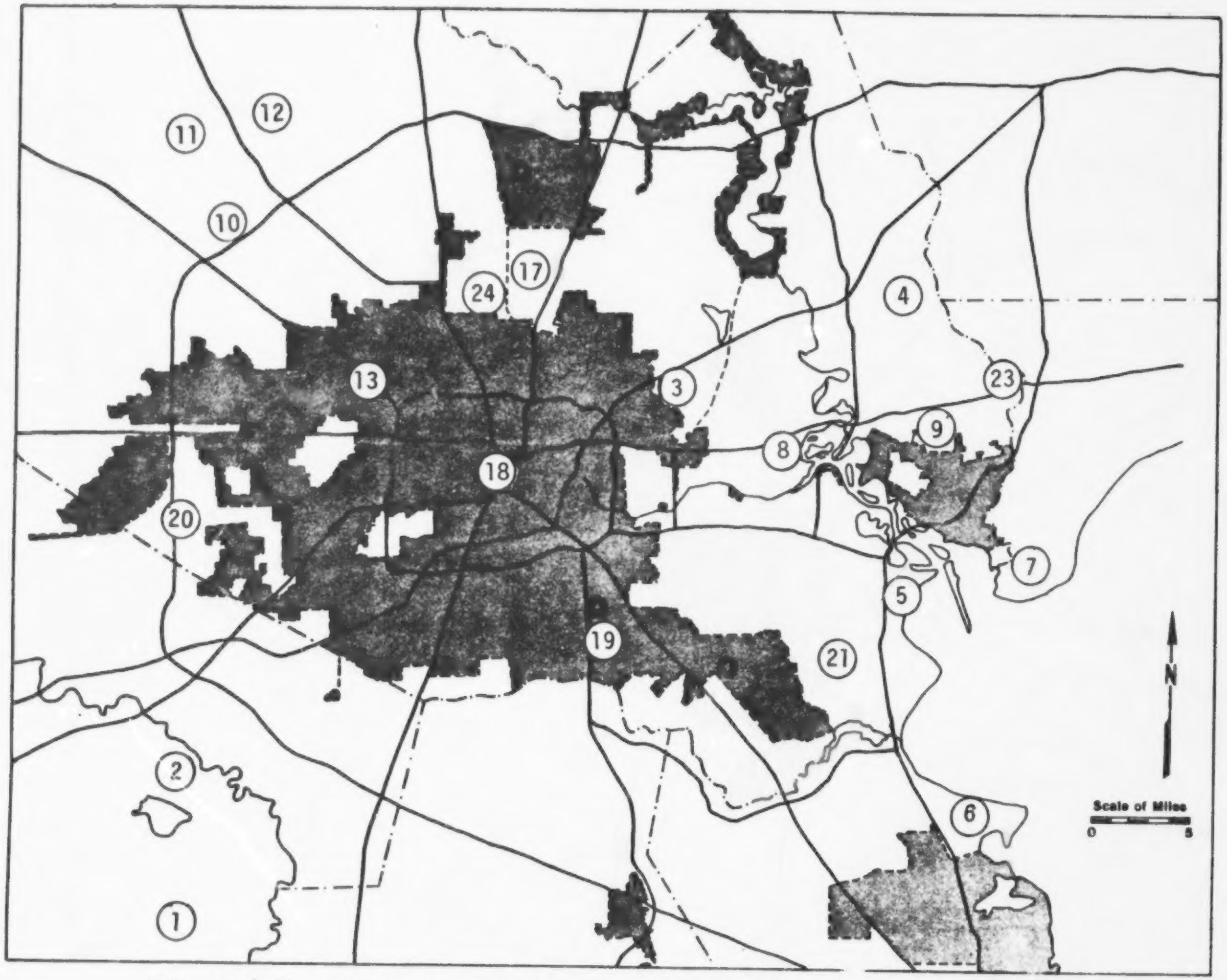
Dezavalla between Elsbeth and Lakeside (Channelview), Harris County (8)

1418 Baker Road, Haris County (9)

10,000 block Jackrabbit Road, Harris County (10)

12,900 block Grant Road, Harris County (11)

9,800 block Louetta Road, Harris County (12)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Scale of Miles
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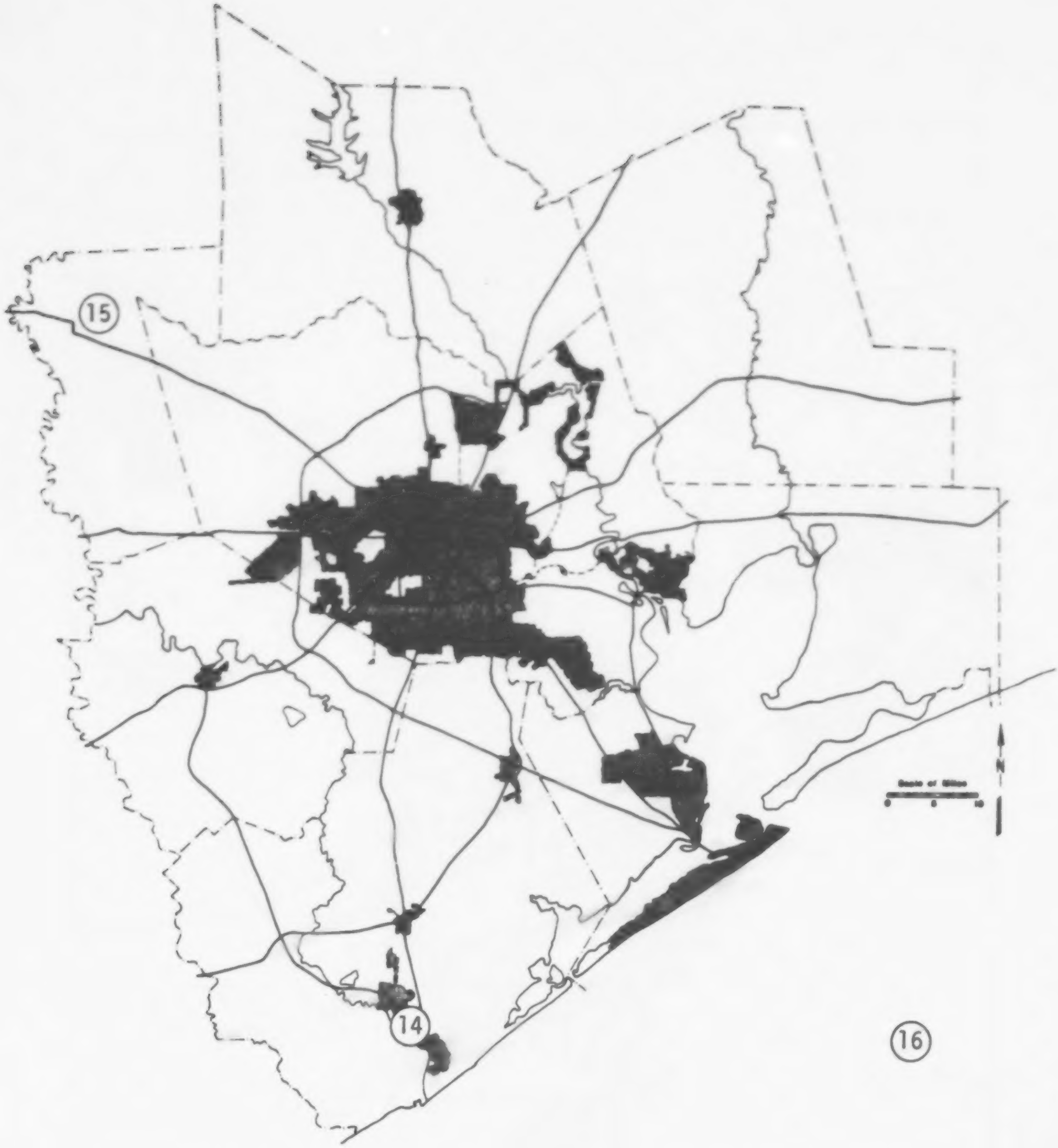
Figure 4-3. Temporary continuous criteria sites in the Houston area.


15
14
16
Scale of Miles
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5
10
N

Figure 4-4. Temporary continuous criteria sites in the Houston area.

Non-Continuous Criteria - Existing Sites

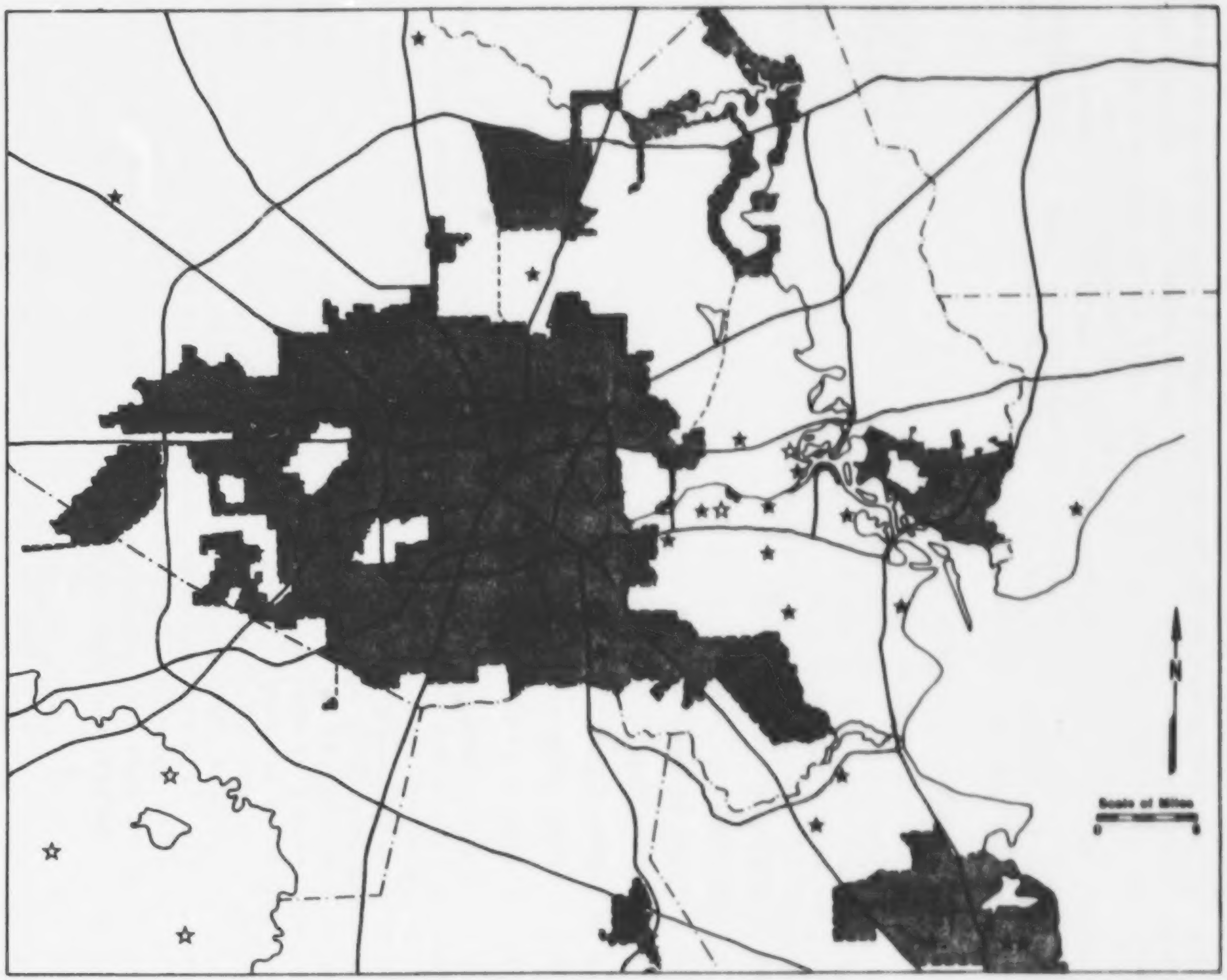
Over 50 non-continuous monitors are currently being operated by government and private agencies in the Texas Gulf Coast Study Area. Figures 4-5 and 4-6 show the locations of these monitors. All of the non-continuous sites have Hi-Vol monitors for TSP, and many also have gas bubblers for oxides, NO_2, NH_3, and aldehydes. The Hi-Vol monitors are operated only once every six days at government operated sites. Most Hi-Vol samples are evaluated for chemical composition. Table 4-3 lists the chemical parameters analyzed from TACB Hi-Vol samples.

Non-Continuous Criteria - Temporary Sites

Several of the studies listed in Table 4-1 have employed non-continuous criteria monitoring on a temporary basis. Detailed measurements of hydrocarbons and aerosols are of particular interest for the Texas Gulf Coast Study. Detailed hydrocarbons (C_1 - C_6) were analyzed during July 1973 and July-August 1974 (University of Houston study), from air samples collected at the following sites:

- University of Houston, Engineering Building,
- City of Houston trailer - Crawford,
- Pasadena Health Department (on Shaw Street),
- Washburn Tunnel,
- La Porte Civic Center (San Jacinto Street), and
- Downtown Houston and Pasadena by helicopter.

During the Houston Urban Plume Study, TEDLAR Bag samples, collected during aircraft flights, were analyzed for hydrocarbon, and a Minnesota Aerosol Analyzer System was used to measure particle size distribution during the flights. Detailed light hydrocarbons were monitored, on a non-continuous basis during July 1976, by Washington State University. Air samples were collected routinely by WSU at three ground sites (Lang, Aldine, and Fuqua), and periodically from aircraft flights over the Houston area. For the HAOS study, respirable particulates were monitored by ERT at the Hornwood, Aldine, Mae Drive, Crawford, and Fuqua sites from June 22 to November 1, 1977 (five days per week). Also, RTI obtained about 400 samples for detailed hydrocarbon analysis, from various sites, between June 22 and October 15, 1977. Finally, detailed hydrocarbon analysis is planned from grab samples to be obtained for the HAPS project during September and October 1978. Detailed aerosol measurements will also be performed for the HAPS project.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Scale of Miles
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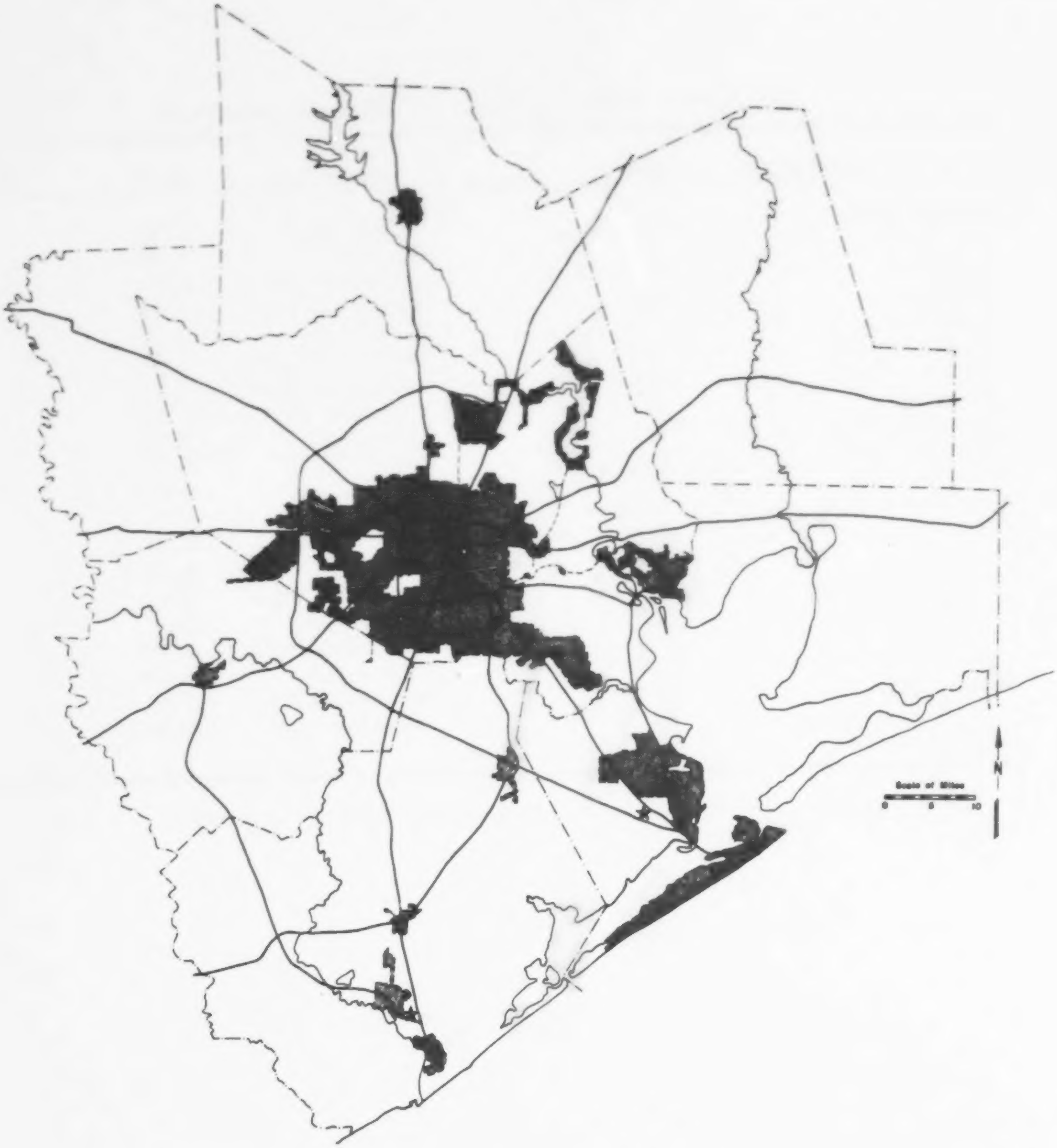
Figure 4-5. Non-continuous criteria, existing monitoring sites, at starred locations, open stars are private sites.


Scale of Miles
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5
10
N

Figure 4-6. Non-continuous criteria, existing monitoring sites, at starred location.

TABLE 4-3. TSP PARAMETERS IN THE TACB DATA FILE

Parameter	MDL*	Parameter	MDL*
Particulate	1.0	Copper (Cu)	0.02
		Tin (Sn)	0.08
Nitrate	0.1	Antimony (sb)	0.04
Sulfate	0.1	Manganese (Mn)	0.06
Organics	0.1	Nickel (Ni)	0.02
Aluminum (Al)	0.6	Molybdenum (Mo)	0.02
Silicon (Si)	0.2	Vanadium (V)	0.004
Fluoride	0.1	Titanium (Ti)	0.006
Chloride (Cl)	0.1	Zinc (Zn)	0.02
Arsenic (As)	0.8	Cobalt (Co)	0.04
Cadmium (Cd)	0.8	Calcium (Ca)	0.01
Beryllium (Be)	0.006	Sodium (Na)	0.1
Iron (Fe)	0.04	Strontium (Sr)	0.02
Lead (Pb)	0.04	Potassium (K)	0.01
Bromide (Br)	0.04	Magnesium (Mg)	0.1
Rubidium (Rb)	0.04	Barium (Ba)	0.1
Zirconium (Zr)	0.02	Phosphorus (P)	0.06
Iodide (I)	0.08	Sulfur (S)	0.04
Boron (B)	0.1	Germanium (Ge)	0.06
Thallium (Tl)	0.08	Selenium (Se)	0.04
Chromium (Cr)	0.06		

* MDL - Minimum detectable limit in micrograms per cubic meter

AIR QUALITY DATA SUMMARIES

The remainder of this section is devoted to summaries of air quality data from Texas Air Control Board continuous criteria monitors in the Houston area.

Each page of the data summaries covers one year of data for one pollutant at one site. The first line on each page gives the name of the site (refer to the continuous criteria site descriptions at the beginning of the section for site information), the year presented, and the pollutant presented. The number of observations (#OBS), arithmetic mean (MEAN), maximum hourly average (MAX), and the second highest hourly average (2ND MAX) are listed by month and year. Months for which no data is available have been omitted, and data for each site extends through October 1977. Hourly variations of each pollutant, averaged over the year or period indicated at the top of each page, are listed under the heading "ANNUAL DIURNAL TRENDS". All pollutant units are parts per million (PPM) and times are Central Standard Time (CST).

ALDINE 1974 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
JUL	419	0.028	0.204	0.165
AUG	417	0.020	0.151	0.159
SEP	493	0.025	0.110	0.108
OCT	530	0.022	0.105	0.098
NOV	171	0.012	0.043	0.043
DEC	401	0.009	0.061	0.060
ANN	2431	0.019	0.204	0.165

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.006	8	0.017	16	0.041
1	0.006	9	0.026	17	0.031
2	0.006	10	0.036	18	0.021
3	0.006	11	0.044	19	0.013
4	0.005	12	0.047	20	0.009
5	0.004	13	0.049	21	0.008
6	0.003	14	0.049	22	0.007
7	0.007	15	0.047	23	0.006

ALDINE 1975 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	543	0.015	0.066	0.058
FEB	228	0.011	0.058	0.058
MAR	623	0.022	0.157	0.158
APR	196	0.037	0.149	0.115
MAY	522	0.030	0.213	0.208
JUN	583	0.028	0.321	0.300
JUL	477	0.028	0.170	0.134
AUG	601	0.021	0.193	0.162
SEP	442	0.029	0.213	0.211
OCT	626	0.023	0.158	0.142
NOV	540	0.015	0.124	0.118
DEC	562	0.014	0.127	0.117
ANN	5943	0.023	0.321	0.300

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.008	8	0.017	16	0.047
1	0.008	9	0.029	17	0.035
2	0.006	10	0.040	18	0.021
3	0.008	11	0.048	19	0.013
4	0.007	12	0.053	20	0.009
5	0.006	13	0.052	21	0.008
6	0.005	14	0.055	22	0.008
7	0.008	15	0.053	23	0.008

```
ALDINE       1976          OZONE (PPM)

        #OBS           MEAN          MAX          2ND MAX

JAN      414          0.014         0.048         0.047
FEB      380          0.020         0.114         0.108
MAR      614          0.022         0.121         0.115
APR      635          0.038         0.162         0.146
MAY      601          0.040         0.141         0.140
JUN      567          0.034         0.255         0.220
JUL      492          0.027         0.225         0.208
AUG      510          0.038         0.272         0.241
SEP      243          0.045         0.184         0.154
OCT       57          0.025         0.055         0.055
NOV      432          0.024         0.092         0.089
DEC      212          0.022         0.082         0.060
ANN     5157          0.029         0.272         0.255

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR     MEAN              HR      MEAN

 0      0.014             8     0.027             16      0.058
 1      0.014             9     0.039             17      0.044
 2      0.014            10     0.051             18      0.030
 3      0.014            11     0.059             19      0.019
 4      0.013            12     0.063             20      0.014
 5      0.011            13     0.065             21      0.013
 6      0.011            14     0.065             22      0.013
 7      0.015            15     0.064             23      0.013
```

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ALDINE      1977          OZONE (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN      241          0.022         0.056        0.055
FEB      357          0.024         0.074        0.070
MAR      573          0.024         0.106        0.098
APR      643          0.031         0.192        0.158
MAY      637          0.032         0.229        0.217
JUN      491          0.035         0.270        0.261
JUL      602          0.025         0.152        0.140
AUG      505          0.021         0.120        0.114
SEP      665          0.017         0.196        0.193
OCT      567          0.025         0.168        0.150
ANN     5281          0.026         0.270        0.261

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR    MEAN             HR     MEAN

 0      0.008             8    0.022            16     0.052
 1      0.009             9    0.033            17     0.042
 2      0.009            10    0.047            18     0.027
 3      0.008            11    0.056            19     0.014
 4      0.008            12    0.062            20     0.009
 5      0.006            13    0.062            21     0.008
 6      0.005            14    0.061            22     0.008
 7      0.010            15    0.058            23     0.008
```

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ALDINE      ALL YEARS    OZONE (PPM)

       #OBS          MEAN          MAX          2ND MAX

JAN   1198.          0.016         0.066         0.058
FEB    965.          0.020         0.114         0.108
MAR   1810.          0.023         0.157         0.138
APR   1474.          0.035         0.192         0.162
MAY   1760.          0.034         0.229         0.217
JUN   1641.          0.032         0.321         0.300
JUL   1990.          0.027         0.225         0.208
AUG   2033.          0.025         0.272         0.241
SEP   1843.          0.025         0.213         0.211
OCT   1780.          0.023         0.168         0.158
NOV   1143.          0.018         0.124         0.118
DEC   1175.          0.014         0.127         0.117
ANN  18812.          0.024         0.321         0.300

                     ANNUAL DIURNAL TRENDS (CST)
HR     MEAN             HR     MEAN              HR     MEAN

 0     0.009             8     0.021             16     0.051
 1     0.010             9     0.033             17     0.039
 2     0.010            10     0.045             18     0.025
 3     0.010            11     0.053             19     0.015
 4     0.009            12     0.057             20     0.010
 5     0.007            13     0.058             21     0.009
 6     0.006            14     0.058             22     0.009
 7     0.010            15     0.057             23     0.009
```

ALDINE 1975 NOX (PPM)

	#OBS	MEAN	MAX	2ND MAX
FEB	176	0.066	0.660	0.450
MAR	508	0.029	0.360	0.350
APR	568	0.018	0.230	0.170
MAY	117	0.014	0.040	0.040
JUN	504	0.020	0.150	0.110
JUL	399	0.026	0.290	0.220
AUG	418	0.036	0.230	0.220
SEP	561	0.034	0.330	0.320
OCT	698	0.043	0.470	0.390
NOV	540	0.052	0.350	0.320
DEC	608	0.057	0.780	0.780
ANN	5097	0.036	0.780	0.780

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.054	8	0.036	16	0.015
1	0.048	9	0.021	17	0.022
2	0.043	10	0.014	18	0.036
3	0.038	11	0.010	19	0.048
4	0.037	12	0.009	20	0.055
5	0.044	13	0.009	21	0.059
6	0.061	14	0.010	22	0.062
7	0.059	15	0.012	23	0.057

```
ALDINE       1976          NOX    (PPM)

        #OBS          MEAN          MAX           2ND MAX

JAN      562          0.057         0.550         0.500
FEB      283          0.035         0.340         0.310
MAR      614          0.026         0.350         0.340
APR      655          0.039         0.290         0.270
MAY      526          0.032         0.250         0.220
JUN       22          0.036         0.120         0.080
JUL      366          0.035         0.210         0.140
AUG      497          0.041         0.200         0.200
SEP      407          0.052         0.510         0.490
OCT      556          0.061         0.640         0.620
NOV      576          0.063         0.740         0.550
DEC      250          0.060         0.570         0.570
ANN     5316          0.045         0.740         0.640

                    ANNUAL DIURNAL TRENDS (CST)
HR      MEAN           HR    MEAN             HR     MEAN

 0      0.065           8    0.045            16     0.018
 1      0.059           9    0.030            17     0.026
 2      0.055          10    0.020            18     0.042
 3      0.049          11    0.015            19     0.060
 4      0.046          12    0.013            20     0.073
 5      0.052          13    0.012            21     0.074
 6      0.070          14    0.012            22     0.074
 7      0.066          15    0.014            23     0.069
```

```
ALDINE       1977          NOX    (PPM)

        #OBS           MEAN           MAX            2ND MAX

JAN     641            0.049          0.540          0.500
FEB     623            0.044          0.510          0.510
MAR     521            0.046          0.450          0.370
APR     456            0.059          0.510          0.480
MAY     626            0.028          0.220          0.180
JUN     615            0.042          0.260          0.250
JUL     676            0.043          0.280          0.270
AUG     631            0.046          0.270          0.230
SEP     507            0.046          0.340          0.270
OCT     579            0.051          0.400          0.380
ANN    5875            0.046          0.540          0.510

                       ANNUAL DIURNAL TRENDS (CST)
HR      MEAN               HR     MEAN               HR     MEAN

 0      0.061               8     0.048              16     0.023
 1      0.055               9     0.030              17     0.028
 2      0.051              10     0.022              18     0.038
 3      0.047              11     0.020              19     0.053
 4      0.046              12     0.018              20     0.057
 5      0.062              13     0.018              21     0.061
 6      0.084              14     0.019              22     0.063
 7      0.074              15     0.021              23     0.063
```

```
ALDINE       ALL YEARS    NOX    (PPM)

       #OBS          MEAN          MAX           2ND MAX

JAN  1223.           0.053         0.550         0.540
FEB  1082.           0.045         0.660         0.510
MAR  1643.           0.033         0.450         0.370
APR  1659.           0.037         0.510         0.480
MAY  1271.           0.028         0.250         0.220
JUN  1141.           0.032         0.260         0.250
JUL  1441.           0.036         0.290         0.280
AUG  1546.           0.042         0.270         0.230
SEP  1475.           0.043         0.510         0.490
OCT  1833.           0.051         0.640         0.620
NOV  1116.           0.058         0.740         0.550
DEC   858.           0.058         0.780         0.780
ANN 16288.           0.043         0.780         0.780

                     ANNUAL DIURNAL TRENDS (CST)
HR     MEAN             HR    MEAN              HR     MEAN

 0     0.060             8    0.043             16     0.019
 1     0.054             9    0.027             17     0.025
 2     0.050            10    0.019             18     0.039
 3     0.045            11    0.015             19     0.054
 4     0.044            12    0.014             20     0.061
 5     0.053            13    0.013             21     0.064
 6     0.072            14    0.014             22     0.066
 7     0.067            15    0.016             23     0.063
```

```
ALDINE       1974          NMHC    (PPM)

        #OBS          MEAN          MAX          2ND MAX

APR       61          0.613         1.300         1.200
MAY       12          0.917         1.400         1.300
JUN      558          0.688         2.600         2.100
JUL      268          0.468         6.500         1.900
AUG      374          0.773         4.700         2.900
SEP      110          0.983         3.900         3.800
OCT      197          0.603         2.000         2.000
NOV      316          0.877         9.900         9.900
DEC      151          0.466         1.900         1.000
ANN     2047          0.710         9.900         9.900

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR    MEAN              HR     MEAN

 0      0.790             8    0.610             16     0.590
 1      0.773             9    0.472             17     0.649
 2      0.709            10    0.477             18     0.751
 3      0.718            11    0.606             19     0.802
 4      0.751            12    0.536             20     0.851
 5      0.781            13    0.485             21     0.908
 6      0.835            14    0.477             22     0.786
 7      0.722            15    0.601             23     0.787
```

ALDINE 1975 NMHC (PPM)

	#OBS	MEAN	MAX	2ND MAX
FEB	109	0.419	0.800	0.800
APR	325	0.917	2.200	1.800
MAY	200	0.857	1.800	1.800
JUN	35	0.426	1.300	1.300
JUL	453	0.336	2.300	2.000
AUG	433	0.393	1.600	1.500
SEP	116	0.428	2.400	1.700
OCT	574	0.640	3.900	3.300
NOV	386	0.669	3.000	2.900
DEC	142	0.598	1.400	1.400
ANN	2773	0.568	3.900	3.300

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.787	8	0.554	16	0.352
1	0.778	9	0.438	17	0.382
2	0.742	10	0.376	18	0.494
3	0.726	11	0.351	19	0.598
4	0.734	12	0.291	20	0.666
5	0.742	13	0.334	21	0.713
6	0.756	14	0.347	22	0.769
7	0.706	15	0.355	23	0.787

ALDINE 1976 NMHC (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	319	1.118	4.100	4.000
FEB	396	0.406	3.300	2.400
MAR	547	0.483	1.900	1.900
APR	626	0.634	2.700	2.700
MAY	396	0.582	2.900	2.400
JUN	428	0.567	2.500	1.800
JUL	206	0.609	1.800	1.800
AUG	223	0.575	2.300	2.100
SEP	70	0.893	1.500	1.400
OCT	386	0.449	3.100	3.100
NOV	200	0.172	1.600	1.400
DEC	11	0.300	0.400	0.400
ANN	3808	0.566	4.100	4.000

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.730	8	0.622	16	0.324
1	0.734	9	0.513	17	0.362
2	0.740	10	0.430	18	0.438
3	0.723	11	0.379	19	0.538
4	0.715	12	0.336	20	0.616
5	0.746	13	0.335	21	0.648
6	0.826	14	0.305	22	0.673
7	0.786	15	0.320	23	0.711

ALDINE 1977 NMHC (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	640	0.577	4.300	4.200
FEB	486	0.433	3.900	3.800
MAR	275	0.389	3.500	2.800
APR	564	0.601	4.500	4.400
MAY	488	0.436	2.200	2.100
JUN	576	0.586	2.800	2.400
JUL	600	0.462	2.300	2.000
AUG	560	0.761	4.100	3.900
SEP	481	0.788	3.100	3.000
OCT	164	1.446	6.700	6.500
ANN	4834	0.648	6.700	6.500

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.733	8	0.603	16	0.408
1	0.721	9	0.449	17	0.436
2	0.743	10	0.401	18	0.494
3	0.741	11	0.352	19	0.595
4	0.753	12	0.350	20	0.625
5	0.821	13	0.360	21	0.660
6	0.942	14	0.373	22	0.692
7	0.836	15	0.408	23	0.715

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ALDINE        ALL YEARS    NMHC    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN    959.          0.757         4.300         4.200
FEB    991.          0.420         3.900         3.800
MAR    822.          0.451         3.500         2.800
APR   1576.          0.679         4.500         4.400
MAY   1096.          0.571         2.900         2.400
JUN   1597.          0.613         2.800         2.600
JUL   1527.          0.445         6.500         2.300
AUG   1590.          0.637         4.700         4.100
SEP    777.          0.772         3.900         3.800
OCT   1321.          0.679         6.700         6.500
NOV    902.          0.632         9.900         9.900
DEC    304.          0.521         1.900         1.400
ANN  13462.          0.598         9.900         9.900

                    ANNUAL  DIURNAL  TRENDS  (CST)
HR      MEAN              HR     MEAN              HR     MEAN

 0      0.752              8     0.599             16     0.399
 1      0.744              9     0.469             17     0.435
 2      0.736             10     0.415             18     0.516
 3      0.729             11     0.399             19     0.611
 4      0.738             12     0.364             20     0.666
 5      0.777             13     0.367             21     0.706
 6      0.854             14     0.363             22     0.717
 7      0.777             15     0.400             23     0.739
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ALDINE      1974        S02   (PPM)

      #OBS          MEAN          MAX          2ND MAX

APR    112          0.000         0.000         0.000
MAY    434          0.000         0.000         0.000
JUN    469          0.000         0.000         0.000
JUL    490          0.000         0.010         0.000
SEP    218          0.000         0.000         0.000
OCT    476          0.000         0.000         0.000
NOV    528          0.000         0.000         0.000
DEC    340          0.000         0.000         0.000
ANN   3067          0.000         0.010         0.000

                    ANNUAL DIURNAL TRENDS (CST)
HR     MEAN            HR     MEAN              HR     MEAN

 0     0.000            8     0.000             16     0.000
 1     0.000            9     0.000             17     0.000
 2     0.000           10     0.000             18     0.000
 3     0.000           11     0.000             19     0.000
 4     0.000           12     0.000             20     0.000
 5     0.000           13     0.000             21     0.000
 6     0.000           14     0.000             22     0.000
 7     0.000           15     0.000             23     0.000
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ALDINE      1975          S02   (PPM)

       #OBS          MEAN          MAX           2ND MAX

JAN     521          0.000         0.020         0.020
FEB     223          0.000         0.010         0.000
MAR     392          0.000         0.020         0.020
APR     273          0.000         0.000         0.000
MAY     114          0.000         0.000         0.000
JUN     342          0.000         0.020         0.020
JUL     430          0.000         0.010         0.010
AUG     385          0.000         0.050         0.030
SEP     355          0.000         0.000         0.000
OCT     474          0.000         0.000         0.000
NOV     540          0.000         0.010         0.000
DEC     608          0.000         0.110         0.100
ANN    4657          0.000         0.110         0.100

                     ANNUAL DIURNAL TRENDS (CST)
HR     MEAN             HR    MEAN             HR    MEAN

 0     0.000             8    0.000            16    0.000
 1     0.000             9    0.000            17    0.000
 2     0.000            10    0.000            18    0.000
 3     0.000            11    0.000            19    0.001
 4     0.000            12    0.000            20    0.001
 5     0.000            13    0.000            21    0.000
 6     0.000            14    0.001            22    0.000
 7     0.000            15    0.000            23    0.000
```

ALDINE 1976 SO2 (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	376	0.000	0.000	0.000
FEB	283	0.000	0.000	0.000
MAR	614	0.000	0.000	0.000
APR	413	0.000	0.010	0.010
MAY	381	0.000	0.000	0.000
JUN	501	0.000	0.000	0.000
JUL	231	0.000	0.000	0.000
SEP	154	0.000	0.000	0.000
OCT	603	0.000	0.000	0.000
NOV	669	0.000	0.000	0.000
DEC	541	0.000	0.000	0.000
ANN	4766	0.000	0.010	0.010

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.000	8	0.000	16	0.000
1	0.000	9	0.000	17	0.000
2	0.000	10	0.000	18	0.000
3	0.000	11	0.000	19	0.000
4	0.000	12	0.000	20	0.000
5	0.000	13	0.000	21	0.000
6	0.000	14	0.000	22	0.000
7	0.000	15	0.000	23	0.000

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ALDINE        1977          SO2    (PPM)

         #OBS           MEAN          MAX           2ND MAX

JAN       457           0.000         0.000         0.000
FEB       527           0.000         0.000         0.000
MAR       666           0.000         0.000         0.000
APR       643           0.000         0.000         0.000
MAY       617           0.000         0.000         0.000
JUN       650           0.000         0.000         0.000
JUL       543           0.000         0.000         0.000
AUG       485           0.000         0.000         0.000
SEP       514           0.000         0.000         0.000
OCT       340           0.000         0.010         0.010
ANN      5442           0.000         0.010         0.010

                        ANNUAL DIURNAL TRENDS (CST)
HR       MEAN              HR     MEAN                HR      MEAN

 0       0.000              8     0.000               16      0.000
 1       0.000              9     0.000               17      0.000
 2       0.000             10     0.000               18      0.000
 3       0.000             11     0.000               19      0.000
 4       0.000             12     0.000               20      0.000
 5       0.000             13     0.000               21      0.000
 6       0.000             14     0.000               22      0.000
 7       0.000             15     0.000               23      0.000
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ALDINE      ALL YEARS    SO2    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN   1354.          0.000         0.020         0.020
FEB   1033.          0.000         0.010         0.000
MAR   1672.          0.000         0.020         0.020
APR   1441.          0.000         0.010         0.010
MAY   1546.          0.000         0.000         0.000
JUN   1962.          0.000         0.020         0.020
JUL   1694.          0.000         0.010         0.010
AUG    870.          0.000         0.050         0.030
SEP   1241.          0.000         0.000         0.000
OCT   1893.          0.000         0.010         0.010
NOV   1737.          0.000         0.010         0.000
DEC   1489.          0.000         0.110         0.100
ANN  17932.          0.000         0.110         0.100

                    ANNUAL DIURNAL TRENDS (CST)
HR     MEAN            HR    MEAN           HR     MEAN

 0     0.000            8    0.000          16     0.000
 1     0.000            9    0.000          17     0.000
 2     0.000           10    0.000          18     0.000
 3     0.000           11    0.000          19     0.000
 4     0.000           12    0.000          20     0.000
 5     0.000           13    0.000          21     0.000
 6     0.000           14    0.000          22     0.000
 7     0.000           15    0.000          23     0.000
```

ALDINE 1974 CO (PPM)

	#OBS	MEAN	MAX	2ND MAX
MAY	13	0.669	1.200	0.900
JUN	576	0.529	3.400	2.800
JUL	280	0.387	2.100	1.900
AUG	374	0.651	3.500	3.400
SEP	110	0.322	1.600	1.400
ANN	1353	0.512	3.500	3.400

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.669	8	0.406	16	0.383
1	0.581	9	0.274	17	0.458
2	0.532	10	0.252	18	0.470
3	0.469	11	0.262	19	0.547
4	0.478	12	0.265	20	0.635
5	0.747	13	0.248	21	0.722
6	1.103	14	0.291	22	0.692
7	0.732	15	0.317	23	0.678

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ALDINE      1975          CO    (PPM)

        #OBS          MEAN          MAX           2ND MAX

APR      184          0.136         1.300         0.600
MAY      198          0.325         3.100         2.200
JUN       35          1.160         3.100         3.000
JUL      454          0.531         4.400         3.700
AUG      433          0.641         3.300         3.200
SEP      116          0.560         3.000         2.700
OCT      575          0.727         7.600         6.700
NOV      386          0.818         5.500         5.200
DEC      141          0.147         1.600         1.300
ANN     2522          0.561         7.600         6.700

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR    MEAN                HR     MEAN

 0      0.860             8    0.539               16     0.241
 1      0.785             9    0.294               17     0.321
 2      0.702            10    0.195               18     0.550
 3      0.609            11    0.211               19     0.732
 4      0.560            12    0.174               20     0.839
 5      0.694            13    0.183               21     0.917
 6      1.013            14    0.219               22     0.950
 7      0.944            15    0.217               23     0.935
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ALDINE      1976          CO   (PPM)

        #OBS         MEAN         MAX          2ND MAX

JAN      319         0.788        6.300        6.300
FEB      396         0.541        7.900        5.600
MAR      547         0.369        3.300        3.000
APR      626         0.499        4.100        3.900
MAY      396         0.608        6.000        5.000
JUN      428         0.571        3.000        2.800
JUL      206         0.451        2.400        1.600
AUG      223         0.635        3.100        2.600
SEP       70         0.191        1.100        0.600
OCT      386         0.911        8.100        7.200
NOV      200         0.525        2.700        2.600
ANN     3797         0.554        8.100        7.900

                     ANNUAL DIURNAL TRENDS (CST)
HR      MEAN           HR     MEAN             HR      MEAN

 0      0.743           8     0.694            16      0.286
 1      0.684           9     0.471            17      0.355
 2      0.627          10     0.354            18      0.495
 3      0.551          11     0.265            19      0.652
 4      0.528          12     0.233            20      0.777
 5      0.624          13     0.238            21      0.799
 6      0.974          14     0.245            22      0.796
 7      1.027          15     0.290            23      0.758
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ALDINE      1977          CO    (PPM)

        #OBS          MEAN          MAX          2ND MAX

MAR       76          0.705         3.300         3.100
APR      500          0.552         4.800         4.800
MAY      426          0.406         2.700         2.600
JUN      576          0.521         4.500         3.900
JUL      600          0.567         4.300         4.100
AUG      560          0.608         3.900         3.200
SEP      481          0.755         6.000         5.300
OCT      164          0.626         5.200         5.100
ANN     3383          0.592         6.000         5.300

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR    MEAN              HR    MEAN

 0      0.731            8    0.514             16    0.316
 1      0.680            9    0.335             17    0.385
 2      0.613           10    0.263             18    0.438
 3      0.559           11    0.239             19    0.588
 4      0.573           12    0.243             20    0.691
 5      0.828           13    0.229             21    0.778
 6      1.375           14    0.254             22    0.781
 7      1.023           15    0.296             23    0.780
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ALDINE       ALL YEARS    CO    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN    319.          0.788         6.300         6.300
FEB    396.          0.541         7.900         5.600
MAR    623.          0.410         3.300         3.300
APR   1310.          0.468         4.800         4.800
MAY   1033.          0.471         6.000         5.000
JUN   1615.          0.551         4.500         3.900
JUL   1540.          0.508         4.400         4.300
AUG   1590.          0.631         3.900         3.500
SEP    777.          0.614         6.000         5.300
OCT   1125.          0.775         8.100         7.600
NOV    586.          0.718         5.500         5.200
DEC    141.          0.147         1.600         1.300
ANN  11055.          0.552         8.100         7.900

                    ANNUAL DIURNAL TRENDS (CST)
HR      MEAN          HR    MEAN               HR      MEAN

 0      0.757          8    0.571              16      0.297
 1      0.693          9    0.368              17      0.369
 2      0.628         10    0.277              18      0.487
 3      0.557         11    0.244              19      0.637
 4      0.543         12    0.227              20      0.747
 5      0.717         13    0.224              21      0.810
 6      1.122         14    0.247              22      0.813
 7      0.971         15    0.279              23      0.795
```

CLUTE 1974 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
AUG	79	0.006	0.015	0.013
SEP	424	0.028	0.110	0.110
OCT	412	0.029	0.094	0.092
NOV	674	0.020	0.116	0.100
DEC	670	0.015	0.091	0.073
ANN	2259	0.020	0.116	0.110

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.015	8	0.018	16	0.032
1	0.015	9	0.026	17	0.025
2	0.015	10	0.030	18	0.019
3	0.014	11	0.035	19	0.018
4	0.014	12	0.037	20	0.016
5	0.013	13	0.039	21	0.015
6	0.009	14	0.039	22	0.015
7	0.011	15	0.036	23	0.015

CLUTE 1975 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	625	0.021	0.094	0.084
FEB	567	0.023	0.071	0.065
MAR	523	0.030	0.099	0.096
APR	582	0.035	0.110	0.096
MAY	632	0.033	0.105	0.103
JUN	381	0.024	0.149	0.143
JUL	547	0.029	0.160	0.155
AUG	515	0.018	0.085	0.072
SEP	608	0.035	0.134	0.134
OCT	551	0.029	0.146	0.122
NOV	536	0.025	0.114	0.108
DEC	631	0.018	0.067	0.060
ANN	6698	0.027	0.160	0.155

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.021	8	0.025	16	0.039
1	0.021	9	0.033	17	0.034
2	0.020	10	0.037	18	0.028
3	0.019	11	0.040	19	0.024
4	0.018	12	0.044	20	0.022
5	0.015	13	0.043	21	0.021
6	0.012	14	0.042	22	0.021
7	0.017	15	0.041	23	0.021

CLUTE 1976 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	358	0.020	0.053	0.050
MAR	281	0.028	0.085	0.080
APR	606	0.042	0.124	0.120
MAY	519	0.036	0.093	0.092
JUN	448	0.033	0.186	0.186
JUL	503	0.016	0.077	0.068
AUG	56	0.027	0.087	0.085
SEP	664	0.037	0.174	0.136
OCT	593	0.032	0.162	0.141
NOV	644	0.019	0.139	0.122
DEC	508	0.018	0.151	0.122
ANN	5180	0.028	0.186	0.186

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.020	8	0.028	16	0.043
1	0.021	9	0.035	17	0.038
2	0.020	10	0.040	18	0.029
3	0.020	11	0.043	19	0.024
4	0.019	12	0.046	20	0.022
5	0.016	13	0.048	21	0.021
6	0.013	14	0.050	22	0.020
7	0.018	15	0.047	23	0.021

CLUTE 1977 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	118	0.015	0.060	0.058
FEB	514	0.034	0.105	0.101
MAR	382	0.033	0.104	0.087
APR	673	0.038	0.152	0.115
MAY	702	0.032	0.125	0.113
JUN	677	0.024	0.185	0.176
JUL	667	0.017	0.089	0.073
AUG	697	0.015	0.106	0.088
SEP	633	0.016	0.101	0.097
OCT	691	0.028	0.096	0.094
ANN	5754	0.025	0.185	0.176

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.020	8	0.025	16	0.036
1	0.020	9	0.031	17	0.033
2	0.019	10	0.036	18	0.028
3	0.018	11	0.038	19	0.024
4	0.017	12	0.038	20	0.022
5	0.014	13	0.039	21	0.021
6	0.012	14	0.036	22	0.019
7	0.017	15	0.037	23	0.019

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CLUTE    ALL YEARS    OZONE (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN   1101.          0.020         0.094         0.084
FEB   1081.          0.028         0.105         0.101
MAR   1186.          0.031         0.104         0.099
APR   1661.          0.038         0.152         0.124
MAY   1853.          0.034         0.125         0.113
JUN   1506.          0.027         0.186         0.186
JUL   1717.          0.021         0.160         0.155
AUG   1347.          0.016         0.106         0.088
SEP   2329.          0.029         0.174         0.136
OCT   2247.          0.030         0.162         0.146
NOV   1854.          0.021         0.139         0.122
DEC   1809.          0.017         0.151         0.122
ANN  19891.          0.026         0.186         0.186

                    ANNUAL  DIURNAL  TRENDS  (CST)
HR      MEAN             HR      MEAN              HR      MEAN

 0      0.020             8      0.025             16      0.038
 1      0.020             9      0.032             17      0.034
 2      0.019            10      0.037             18      0.028
 3      0.018            11      0.040             19      0.023
 4      0.017            12      0.042             20      0.021
 5      0.015            13      0.042             21      0.020
 6      0.012            14      0.043             22      0.019
 7      0.017            15      0.041             23      0.020
```

CLUTE 1975 NOX (PPM)

	#OBS	MEAN	MAX	2ND MAX
APR	467	0.016	0.220	0.210
MAY	479	0.015	0.180	0.170
JUN	534	0.021	0.140	0.140
JUL	704	0.019	0.190	0.190
AUG	640	0.022	0.180	0.160
SEP	651	0.013	0.160	0.150
OCT	504	0.019	0.130	0.130
NOV	536	0.027	0.210	0.210
DEC	631	0.026	0.260	0.260
ANN	5146	0.020	0.260	0.260

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.023	8	0.018	16	0.015
1	0.022	9	0.014	17	0.016
2	0.022	10	0.012	18	0.019
3	0.023	11	0.011	19	0.023
4	0.022	12	0.011	20	0.025
5	0.023	13	0.012	21	0.025
6	0.032	14	0.013	22	0.025
7	0.026	15	0.014	23	0.024

CLUTE 1976 NOX (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	360	0.020	0.250	0.240
FEB	149	0.026	0.160	0.150
MAR	482	0.021	0.270	0.180
APR	116	0.019	0.170	0.110
MAY	523	0.020	0.150	0.130
JUN	241	0.021	0.130	0.130
SEP	664	0.020	0.120	0.110
OCT	593	0.024	0.220	0.180
NOV	616	0.033	0.280	0.200
DEC	417	0.030	0.300	0.290
ANN	4161	0.023	0.300	0.290

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.029	8	0.025	16	0.018
1	0.024	9	0.018	17	0.021
2	0.023	10	0.016	18	0.026
3	0.021	11	0.016	19	0.032
4	0.022	12	0.013	20	0.036
5	0.022	13	0.013	21	0.035
6	0.033	14	0.013	22	0.033
7	0.036	15	0.013	23	0.029

```
CLUTE     1977          NOX    (PPM)

        #OBS          MEAN          MAX           2ND MAX

JAN      211          0.019         0.210         0.170
FEB      356          0.026         0.300         0.280
MAR      572          0.020         0.240         0.220
APR      506          0.030         0.350         0.320
MAY      702          0.025         0.230         0.210
JUN      678          0.038         0.220         0.210
JUL      649          0.030         0.200         0.200
AUG      696          0.019         0.200         0.180
SEP      293          0.024         0.180         0.140
OCT      282          0.049         0.270         0.250
ANN     4945          0.028         0.350         0.320

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR     MEAN               HR     MEAN

 0      0.034            8     0.027              16     0.021
 1      0.031            9     0.022              17     0.022
 2      0.028           10     0.017              18     0.025
 3      0.027           11     0.017              19     0.030
 4      0.025           12     0.019              20     0.031
 5      0.028           13     0.018              21     0.034
 6      0.041           14     0.021              22     0.037
 7      0.036           15     0.024              23     0.038
```

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CLUTE     ALL YEARS     NOX     (PPM)

        #OBS           MEAN           MAX          2ND MAX

JAN    571.           0.020          0.250          0.240
FEB    505.           0.026          0.300          0.280
MAR   1054.           0.020          0.270          0.240
APR   1089.           0.023          0.350          0.320
MAY   1704.           0.020          0.230          0.210
JUN   1453.           0.029          0.220          0.210
JUL   1353.           0.024          0.200          0.200
AUG   1336.           0.021          0.200          0.180
SEP   1608.           0.018          0.180          0.160
OCT   1379.           0.027          0.270          0.250
NOV   1152.           0.030          0.280          0.210
DEC   1048.           0.028          0.300          0.290
ANN  14252.           0.024          0.350          0.320

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR     MEAN             HR     MEAN

 0      0.029             8     0.023            16     0.018
 1      0.026             9     0.018            17     0.019
 2      0.025            10     0.015            18     0.023
 3      0.024            11     0.015            19     0.028
 4      0.023            12     0.015            20     0.030
 5      0.024            13     0.015            21     0.031
 6      0.035            14     0.016            22     0.031
 7      0.032            15     0.017            23     0.030
```

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CLUTE     1974          NMHC    (PPM)

        #OBS         MEAN          MAX          2ND MAX

AUG      165         1.268        4.200          3.500
SEP      184         0.854        5.900          4.600
OCT       82         0.624        3.800          1.800
NOV      276         1.064        3.700          3.600
DEC      511         1.425        5.400          5.200
ANN     1218         1.047        5.900          5.400

                     ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR    MEAN             HR     MEAN

 0      1.244            8    1.204            16     1.018
 1      1.365            9    1.081            17     1.106
 2      1.406           10    1.081            18     1.172
 3      1.363           11    1.018            19     1.238
 4      1.437           12    0.924            20     1.240
 5      1.312           13    0.933            21     1.145
 6      1.265           14    0.960            22     1.168
 7      1.356           15    0.976            23     1.236
```

```
CLUTE     1975          NMHC    (PPM)

       #OBS          MEAN          MAX          2ND MAX

JAN     346          0.888         3.100         3.100
FEB     567          0.789         4.400         3.900
MAR     354          0.456         3.100         3.000
APR     606          0.320         3.300         3.100
MAY     590          0.246         2.800         2.400
JUN     384          0.465         1.800         1.700
JUL     704          0.394         5.600         3.000
AUG     590          0.455         3.200         3.000
SEP     101          0.329         1.600         1.400
OCT     369          0.289         2.600         2.000
NOV     366          0.413         2.400         2.400
DEC     314          0.375         2.300         2.000
ANN    5291          0.452         5.600         4.400

                     ANNUAL DIURNAL TRENDS (CST)
HR     MEAN             HR     MEAN             HR     MEAN

 0     0.552             8     0.451            16     0.332
 1     0.547             9     0.347            17     0.340
 2     0.567            10     0.312            18     0.385
 3     0.573            11     0.307            19     0.443
 4     0.523            12     0.309            20     0.459
 5     0.550            13     0.321            21     0.504
 6     0.668            14     0.316            22     0.506
 7     0.601            15     0.319            23     0.507
```

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CLUTE     1976          NMHC    (PPM)

        #OBS          MEAN          MAX           2ND MAX

JAN      226          0.436         2.100         2.100
FEB      394          0.916         4.000         3.800
MAR      149          0.703         2.700         2.700
APR      153          0.484         2.400         2.000
MAY      485          0.622         3.500         3.300
JUN      448          0.480         2.300         2.000
JUL      371          0.373         2.500         2.200
SEP      326          0.737         3.000         2.800
NOV      196          1.002         4.400         4.000
DEC      339          0.951         5.600         4.700
ANN     3087          0.670         5.600         4.700

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR    MEAN             HR     MEAN

 0      0.743             8    0.687            16     0.511
 1      0.836             9    0.574            17     0.464
 2      0.821            10    0.536            18     0.526
 3      0.822            11    0.551            19     0.618
 4      0.778            12    0.525            20     0.704
 5      0.813            13    0.528            21     0.689
 6      0.867            14    0.532            22     0.668
 7      0.806            15    0.517            23     0.710
```

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CLUTE     1977          NMHC    (PPM)

          #OBS          MEAN          MAX           2ND MAX

JAN         69          1.028         1.500         1.300
FEB        355          0.924         3.000         2.700
MAR        589          1.177         4.400         3.400
APR        551          0.914         3.600         3.100
MAY        677          0.712         4.800         2.900
JUN        571          0.984         3.700         3.100
JUL        429          1.417         7.200         7.200
AUG        426          2.764         6.900         6.100
SEP        463          4.500         7.200         6.900
OCT        583          4.740         7.400         7.300
ANN       4733          1.916         7.400         7.300

                        ANNUAL DIURNAL TRENDS (CST)
 HR       MEAN            HR    MEAN              HR      MEAN

  0       2.156            8    1.973             16      1.766
  1       2.135            9    1.859             17      1.818
  2       2.160           10    1.722             18      1.879
  3       2.181           11    1.733             19      1.990
  4       2.154           12    1.711             20      2.045
  5       2.102           13    1.712             21      2.115
  6       2.183           14    1.680             22      2.170
  7       2.135           15    1.703             23      2.200
```

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CLUTE     ALL YEARS     NMHC     (PPM)

         #OBS          MEAN          MAX          2ND MAX

JAN    641.           0.744         3.100         3.100
FEB   1316.           0.863         4.400         4.000
MAR   1092.           0.876         4.400         3.400
APR   1310.           0.589         3.600         3.300
MAY   1752.           0.530         4.800         3.500
JUN   1403.           0.681         3.700         3.100
JUL   1504.           0.681         7.200         7.200
AUG   1181.           1.402         6.900         6.100
SEP   1094.           2.381         7.200         6.900
OCT   1034.           2.825         7.400         7.300
NOV    838.           0.765         4.400         4.000
DEC   1164.           1.004         5.600         5.400
ANN  14329.           1.112         7.400         7.300

                     ANNUAL DIURNAL TRENDS (CST)
HR      MEAN           HR     MEAN             HR      MEAN

 0      1.180           8     1.084            16      0.894
 1      1.202           9     0.967            17      0.915
 2      1.218          10     0.884            18      0.973
 3      1.224          11     0.875            19      1.056
 4      1.195          12     0.872            20      1.104
 5      1.183          13     0.890            21      1.130
 6      1.261          14     0.875            22      1.146
 7      1.215          15     0.881            23      1.172
```

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CLUTE    1974          SO2   (PPM)

        #OBS        MEAN        MAX         2ND MAX

JUL      95         0.001       0.050       0.000
AUG     243         0.000       0.000       0.000
SEP     674         0.000       0.000       0.000
OCT     583         0.000       0.010       0.000
NOV     670         0.000       0.020       0.000
DEC     571         0.000       0.000       0.000
ANN    2836         0.000       0.050       0.020

                    ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR   MEAN              HR    MEAN

 0      0.000            8   0.000             16    0.000
 1      0.000            9   0.000             17    0.000
 2      0.000           10   0.000             18    0.000
 3      0.000           11   0.000             19    0.000
 4      0.000           12   0.000             20    0.000
 5      0.000           13   0.000             21    0.000
 6      0.000           14   0.000             22    0.000
 7      0.000           15   0.000             23    0.000
```

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CLUTE     1975          SO2    (PPM)

        #OBS         MEAN          MAX          2ND MAX

JAN      472         0.000         0.020         0.010
FEB      385         0.000         0.010         0.010
MAR      405         0.000         0.010         0.000
APR      160         0.000         0.000         0.000
MAY       83         0.000         0.000         0.000
JUN      319         0.000         0.000         0.000
JUL       49         0.000         0.000         0.000
AUG      567         0.000         0.000         0.000
SEP      316         0.000         0.000         0.000
OCT      481         0.000         0.000         0.000
NOV      366         0.000         0.000         0.000
DEC      501         0.000         0.000         0.000
ANN     4104         0.000         0.020         0.010

                    ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR    MEAN              HR    MEAN

 0      0.000            8    0.000             16    0.000
 1      0.000            9    0.000             17    0.000
 2      0.000           10    0.000             18    0.000
 3      0.000           11    0.000             19    0.000
 4      0.000           12    0.000             20    0.000
 5      0.000           13    0.000             21    0.000
 6      0.000           14    0.000             22    0.000
 7      0.000           15    0.000             23    0.000
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CLUTE     1976          SO2    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN       49          0.000         0.000         0.000
FEB      270          0.000         0.000         0.000
MAR      549          0.000         0.000         0.000
APR      269          0.000         0.000         0.000
JUN      188          0.000         0.000         0.000
JUL      106          0.000         0.000         0.000
SEP      573          0.000         0.090         0.000
OCT      170          0.000         0.000         0.000
NOV      278          0.000         0.020         0.000
DEC      140          0.000         0.000         0.000
ANN     2592          0.000         0.090         0.020

                    ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR    MEAN              HR     MEAN

 0      0.000            8    0.000             16     0.000
 1      0.000            9    0.000             17     0.000
 2      0.000           10    0.000             18     0.000
 3      0.000           11    0.000             19     0.000
 4      0.000           12    0.000             20     0.000
 5      0.000           13    0.000             21     0.000
 6      0.000           14    0.000             22     0.000
 7      0.000           15    0.000             23     0.000
```

CLUTE 1977 SO2 (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	9	0.000	0.000	0.000
FEB	442	0.000	0.010	0.010
MAR	606	0.000	0.020	0.020
APR	528	0.000	0.000	0.000
MAY	594	0.000	0.000	0.000
JUN	665	0.000	0.010	0.000
JUL	599	0.000	0.000	0.000
AUG	447	0.000	0.000	0.000
SEP	302	0.000	0.000	0.000
OCT	631	0.001	0.010	0.010
ANN	4823	0.000	0.020	0.020

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.000	8	0.000	16	0.000
1	0.000	9	0.000	17	0.000
2	0.000	10	0.000	18	0.000
3	0.000	11	0.000	19	0.000
4	0.000	12	0.000	20	0.000
5	0.000	13	0.000	21	0.000
6	0.000	14	0.000	22	0.000
7	0.000	15	0.000	23	0.000

```
CLUTE     ALL YEARS     SO2    (PPM)

          #OBS          MEAN          MAX           2ND MAX

JAN    530.            0.000         0.020          0.010
FEB   1097.            0.000         0.010          0.010
MAR   1560.            0.000         0.020          0.020
APR    957.            0.000         0.000          0.000
MAY    677.            0.000         0.000          0.000
JUN   1172.            0.000         0.010          0.000
JUL    849.            0.000         0.050          0.000
AUG   1257.            0.000         0.000          0.000
SEP   1865.            0.000         0.090          0.000
OCT   1865.            0.000         0.010          0.010
NOV   1314.            0.000         0.020          0.020
DEC   1212.            0.000         0.000          0.000
ANN  14355.            0.000         0.090          0.050

                   ANNUAL DIURNAL TRENDS (CST)
HR      MEAN          HR    MEAN               HR     MEAN

 0      0.000          8    0.000              16     0.000
 1      0.000          9    0.000              17     0.000
 2      0.000         10    0.000              18     0.000
 3      0.000         11    0.000              19     0.000
 4      0.000         12    0.000              20     0.000
 5      0.000         13    0.000              21     0.000
 6      0.000         14    0.000              22     0.000
 7      0.000         15    0.000              23     0.000
```

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CLUTE     1974          CO    (PPM)

       #OBS          MEAN          MAX          2ND MAX

AUG     27          0.922         1.500         1.200
SEP    184          1.247         2.100         1.600
OCT     82          0.056         1.000         0.300
NOV    276          0.363         8.900         6.000
DEC    511          0.564         9.300         5.900
ANN   1080          0.630         9.300         8.900

                    ANNUAL DIURNAL TRENDS (CST)
HR     MEAN           HR     MEAN            HR     MEAN

 0     0.726           8     0.755           16     0.473
 1     0.635           9     0.444           17     0.568
 2     0.624          10     0.359           18     0.719
 3     0.509          11     0.389           19     0.791
 4     0.474          12     0.350           20     0.891
 5     0.452          13     0.361           21     0.800
 6     0.602          14     0.366           22     0.802
 7     0.974          15     0.411           23     0.755
```

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CLUTE    1975         CO    (PPM)

        #OBS          MEAN         MAX          2ND MAX

JAN      346          0.601        7.600         7.400
FEB      567          0.465        2.500         2.500
MAR      354          0.405        2.200         1.800
APR      607          0.175        1.600         1.400
MAY      590          0.244        2.300         1.500
JUN      384          0.269        1.200         1.200
JUL      704          0.248        2.700         2.400
AUG      586          0.305        2.000         2.000
SEP      101          0.313        1.800         1.500
OCT      369          0.192        2.800         1.500
NOV      366          0.352        3.200         2.400
DEC      314          0.426        5.500         4.500
ANN     5290          0.333        7.600         7.400

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN           HR    MEAN            HR     MEAN

 0      0.300           8    0.362           16     0.243
 1      0.279           9    0.242           17     0.250
 2      0.259          10    0.218           18     0.326
 3      0.249          11    0.211           19     0.393
 4      0.237          12    0.216           20     0.433
 5      0.301          13    0.229           21     0.440
 6      0.623          14    0.221           22     0.400
 7      0.562          15    0.258           23     0.335
```

CLUTE 1976 CO (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	226	0.271	2.600	2.200
FEB	394	0.370	5.200	3.600
MAR	149	0.248	1.400	0.800
APR	153	0.256	2.000	1.600
MAY	465	0.233	3.100	2.100
JUN	448	0.508	4.400	4.100
JUL	371	0.244	3.100	2.600
SEP	326	0.305	2.400	2.300
NOV	196	0.239	3.400	3.300
DEC	339	0.255	5.200	3.100
ANN	3087	0.293	5.200	5.200

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.290	8	0.349	16	0.258
1	0.289	9	0.248	17	0.278
2	0.257	10	0.200	18	0.282
3	0.222	11	0.214	19	0.338
4	0.236	12	0.219	20	0.383
5	0.302	13	0.204	21	0.406
6	0.587	14	0.200	22	0.360
7	0.605	15	0.217	23	0.328

CLUTE 1977 CO (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	69	0.304	2.400	1.800
FEB	355	0.301	5.500	4.600
MAR	514	0.161	5.200	4.200
APR	650	0.268	2.900	2.900
MAY	677	0.101	1.000	1.000
JUN	571	0.148	2.200	2.000
JUL	429	0.073	1.000	1.000
AUG	426	0.110	0.800	0.600
SEP	483	0.242	2.700	2.500
OCT	583	0.240	3.500	2.500
ANN	4757	0.195	5.500	5.200

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.193	8	0.224	16	0.131
1	0.167	9	0.140	17	0.128
2	0.144	10	0.136	18	0.139
3	0.134	11	0.110	19	0.200
4	0.123	12	0.111	20	0.236
5	0.162	13	0.113	21	0.260
6	0.377	14	0.122	22	0.257
7	0.379	15	0.140	23	0.228

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CLUTE    ALL YEARS     CO    (PPM)

       #OBS           MEAN          MAX           2ND MAX

JAN    641.          0.453         7.600          7.400
FEB   1316.          0.392         5.500          5.200
MAR   1017.          0.258         5.200          4.200
APR   1410.          0.227         2.900          2.900
MAY   1752.          0.186         3.100          2.300
JUN   1403.          0.296         4.400          4.100
JUL   1504.          0.198         3.100          2.700
AUG   1041.          0.241         2.000          2.000
SEP   1094.          0.436         2.700          2.500
OCT   1034.          0.208         3.500          2.800
NOV    838.          0.329         8.900          6.000
DEC   1164.          0.436         9.300          5.900
ANN  14214.          0.305         9.300          8.900

                     ANNUAL DIURNAL TRENDS (CST)
HR     MEAN          HR     MEAN               HR     MEAN

 0     0.294          8     0.341              16     0.226
 1     0.271          9     0.223              17     0.240
 2     0.247         10     0.198              18     0.284
 3     0.224         11     0.191              19     0.347
 4     0.216         12     0.193              20     0.392
 5     0.266         13     0.195              21     0.400
 6     0.531         14     0.195              22     0.374
 7     0.541         15     0.221              23     0.330
```

MAE DRIVE 1973 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
APR	58	0.030	0.088	0.078
MAY	402	0.020	0.093	0.092
JUN	578	0.020	0.166	0.160
JUL	595	0.030	0.256	0.218
AUG	485	0.029	0.247	0.227
SEP	366	0.020	0.175	0.167
OCT	456	0.015	0.150	0.137
NOV	597	0.012	0.076	0.070
DEC	644	0.012	0.071	0.071
ANN	4181	0.021	0.256	0.247

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.006	8	0.014	16	0.036
1	0.006	9	0.031	17	0.026
2	0.006	10	0.038	18	0.017
3	0.006	11	0.049	19	0.010
4	0.005	12	0.051	20	0.007
5	0.004	13	0.051	21	0.005
6	0.003	14	0.047	22	0.004
7	0.008	15	0.043	23	0.005

MAE DRIVE 1974 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	601	0.011	0.148	0.120
FEB	633	0.022	0.082	0.078
MAR	672	0.020	0.161	0.152
APR	368	0.024	0.091	0.077
MAY	706	0.023	0.170	0.160
JUN	413	0.035	0.205	0.161
JUL	666	0.025	0.219	0.167
AUG	698	0.020	0.135	0.135
SEP	587	0.020	0.139	0.126
OCT	641	0.021	0.131	0.114
NOV	429	0.010	0.091	0.073
DEC	667	0.011	0.083	0.074
ANN	7081	0.020	0.219	0.205

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.009	8	0.016	16	0.036
1	0.008	9	0.026	17	0.028
2	0.008	10	0.034	18	0.021
3	0.008	11	0.041	19	0.015
4	0.007	12	0.044	20	0.011
5	0.005	13	0.046	21	0.010
6	0.004	14	0.043	22	0.009
7	0.008	15	0.040	23	0.009

```
MAE DRIVE  1975          OZONE (PPM)

       #OBS          MEAN          MAX          2ND MAX

JAN     581          0.010         0.073         0.071
FEB     222          0.009         0.081         0.080
APR     408          0.021         0.111         0.097
MAY     222          0.035         0.175         0.150
JUN     560          0.023         0.288         0.223
JUL     651          0.023         0.195         0.181
AUG     629          0.019         0.189         0.175
SEP     600          0.023         0.170         0.151
OCT     515          0.018         0.139         0.122
NOV     597          0.015         0.139         0.136
DEC     541          0.011         0.101         0.099
ANN    5526          0.019         0.288         0.223

                     ANNUAL DIURNAL TRENDS (CST)
HR     MEAN            HR    MEAN            HR     MEAN

 0     0.007            8    0.015           16     0.036
 1     0.007            9    0.024           17     0.025
 2     0.007           10    0.035           18     0.016
 3     0.006           11    0.043           19     0.010
 4     0.005           12    0.045           20     0.008
 5     0.004           13    0.046           21     0.006
 6     0.003           14    0.049           22     0.006
 7     0.006           15    0.044           23     0.006
```

MAE DRIVE 1976 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	320	0.012	0.055	0.052
FEB	560	0.019	0.097	0.093
MAR	577	0.016	0.094	0.090
APR	625	0.029	0.148	0.133
MAY	670	0.030	0.190	0.173
JUN	504	0.026	0.166	0.160
JUL	632	0.020	0.297	0.267
AUG	313	0.034	0.222	0.188
SEP	430	0.028	0.235	0.209
OCT	713	0.018	0.188	0.172
NOV	648	0.010	0.096	0.091
DEC	637	0.011	0.092	0.088
ANN	6629	0.021	0.297	0.267

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.009	8	0.015	16	0.039
1	0.009	9	0.025	17	0.030
2	0.008	10	0.034	18	0.021
3	0.008	11	0.042	19	0.014
4	0.007	12	0.048	20	0.012
5	0.005	13	0.050	21	0.010
6	0.004	14	0.051	22	0.009
7	0.007	15	0.045	23	0.009

MAE DRIVE 1977 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	654	0.009	0.104	0.102
FEB	567	0.021	0.100	0.095
MAR	590	0.022	0.121	0.106
APR	556	0.026	0.163	0.154
MAY	710	0.032	0.220	0.195
JUN	554	0.029	0.222	0.216
JUL	682	0.024	0.160	0.152
AUG	693	0.020	0.163	0.144
SEP	635	0.016	0.172	0.167
OCT	527	0.026	0.152	0.148
ANN	6168	0.022	0.222	0.220

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.008	8	0.016	16	0.042
1	0.006	9	0.026	17	0.035
2	0.008	10	0.038	18	0.024
3	0.008	11	0.046	19	0.017
4	0.007	12	0.052	20	0.013
5	0.005	13	0.052	21	0.010
6	0.004	14	0.051	22	0.010
7	0.008	15	0.047	23	0.009

```
MAE DRIVE  ALL YEARS    OZONE (PPM)

        #OBS          MEAN          MAX           2ND MAX

JAN   2156.          0.010         0.148         0.120
FEB   1982.          0.019         0.100         0.097
MAR   1839.          0.019         0.161         0.152
APR   2015.          0.025         0.163         0.154
MAY   2710.          0.028         0.220         0.195
JUN   2609.          0.026         0.288         0.223
JUL   3226.          0.024         0.297         0.267
AUG   2818.          0.023         0.247         0.227
SEP   2618.          0.021         0.235         0.209
OCT   2852.          0.020         0.188         0.172
NOV   2271.          0.012         0.139         0.136
DEC   2489.          0.011         0.101         0.099
ANN  29585.          0.020         0.297         0.288

                     ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR     MEAN              HR     MEAN

 0      0.008             8     0.015             16     0.038
 1      0.008             9     0.026             17     0.029
 2      0.008            10     0.036             18     0.020
 3      0.007            11     0.044             19     0.013
 4      0.006            12     0.048             20     0.011
 5      0.005            13     0.049             21     0.009
 6      0.004            14     0.048             22     0.008
 7      0.008            15     0.044             23     0.008
```

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MAE DRIVE  1975          NOX    (PPM)

        #OBS          MEAN          MAX          2ND MAX

MAR      384          0.060         0.860         0.750
APR      474          0.051         0.480         0.430
MAY      196          0.025         0.150         0.150
JUN      533          0.054         0.330         0.290
JUL      567          0.079         0.810         0.480
AUG      387          0.054         0.440         0.290
SEP      579          0.087         0.940         0.680
OCT      469          0.111         0.800         0.730
NOV      334          0.133         0.670         0.660
DEC      188          0.087         0.390         0.380
ANN     4111          0.074         0.940         0.860

                   ANNUAL DIURNAL TRENDS (CST)
HR     MEAN             HR     MEAN             HR     MEAN

 0     0.085             8     0.072            16     0.045
 1     0.077             9     0.049            17     0.060
 2     0.073            10     0.041            18     0.068
 3     0.070            11     0.033            19     0.077
 4     0.088            12     0.033            20     0.090
 5     0.143            13     0.032            21     0.091
 6     0.170            14     0.035            22     0.095
 7     0.126            15     0.041            23     0.091
```

```
MAE DRIVE  1976          NOX    (PPM)

        #OBS          MEAN          MAX           2ND MAX

JAN       32          0.038         0.090         0.060
FEB      270          0.075         0.690         0.490
MAR       57          0.016         0.050         0.050
APR      337          0.078         0.630         0.600
MAY      422          0.069         0.550         0.540
JUN      232          0.048         0.280         0.260
AUG      545          0.055         0.510         0.350
SEP      441          0.063         0.590         0.490
OCT      645          0.079         0.870         0.560
NOV      600          0.097         0.960         0.800
DEC      635          0.112         1.070         1.060
ANN     4216          0.066         1.070         1.060

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR     MEAN               HR      MEAN

 0      0.096             8     0.088              16      0.044
 1      0.097             9     0.056              17      0.055
 2      0.091            10     0.040              18      0.068
 3      0.085            11     0.037              19      0.073
 4      0.090            12     0.031              20      0.081
 5      0.126            13     0.033              21      0.086
 6      0.158            14     0.034              22      0.092
 7      0.140            15     0.038              23      0.096
```

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MAE DRIVE  1977          NOX   (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN      482          0.083         0.760         0.650
FEB      508          0.071         0.810         0.730
MAR      574          0.070         0.660         0.790
APR      554          0.087         0.980         0.910
MAY      235          0.050         0.390         0.300
JUN      534          0.053         0.660         0.540
JUL      348          0.057         0.270         0.240
AUG      115          0.081         0.390         0.320
OCT      272          0.118         0.630         0.530
ANN     3622          0.075         0.980         0.910

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR     MEAN              HR     MEAN

 0      0.086            8     0.099             16     0.045
 1      0.084            9     0.063             17     0.052
 2      0.079           10     0.047             18     0.064
 3      0.077           11     0.041             19     0.073
 4      0.083           12     0.038             20     0.078
 5      0.115           13     0.038             21     0.079
 6      0.147           14     0.040             22     0.073
 7      0.133           15     0.042             23     0.083
```

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MAE DRIVE  ALL YEARS    NOX   (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN    514.          0.080         0.760         0.650
FEB    778.          0.073         0.810         0.730
MAR   1015.          0.063         0.860         0.860
APR   1365.          0.073         0.980         0.910
MAY    853.          0.054         0.550         0.540
JUN   1299.          0.053         0.660         0.540
JUL    915.          0.071         0.810         0.480
AUG   1047.          0.058         0.510         0.440
SEP   1020.          0.076         0.940         0.680
OCT   1386.          0.097         0.870         0.800
NOV    934.          0.110         0.960         0.800
DEC    823.          0.106         1.070         1.060
ANN  11949.          0.076         1.070         1.060

                     ANNUAL  DIURNAL  TRENDS (CST)
HR     MEAN             HR    MEAN                HR     MEAN

 0     0.089             8    0.086               16     0.045
 1     0.086             9    0.056               17     0.056
 2     0.081            10    0.042               18     0.067
 3     0.077            11    0.037               19     0.074
 4     0.087            12    0.034               20     0.083
 5     0.129            13    0.034               21     0.086
 6     0.159            14    0.036               22     0.087
 7     0.133            15    0.040               23     0.090
```

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MAE DRIVE  1973          NMHC   (PPM)

       #OBS          MEAN           MAX           2ND MAX

JUN     349          0.359          7.500          5.000
JUL     444          0.962          2.600          2.500
AUG      87          0.845          3.300          1.600
SEP     219          0.298          3.200          3.100
OCT      64          0.275          1.000          1.000
NOV     212          0.414          2.900          2.400
DEC     228          0.618          4.000          3.500
ANN    1603          0.539          7.500          5.000

                     ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR     MEAN              HR     MEAN

 0      0.708            8     0.695             16     0.374
 1      0.706            9     0.509             17     0.401
 2      0.900           10     0.446             18     0.500
 3      0.778           11     0.375             19     0.553
 4      0.646           12     0.348             20     0.655
 5      0.761           13     0.326             21     0.701
 6      0.807           14     0.310             22     0.723
 7      0.681           15     0.324             23     0.689
```

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MAE DRIVE  1974         NMHC   (PPM)

       #OBS         MEAN          MAX          2ND MAX

JAN      48         0.365         2.300         2.200
FEB     173         0.212         3.300         2.100
MAR     270         0.159         1.700         1.600
APR     122         0.522         3.000         2.900
MAY     580         0.915        10.900         9.300
JUN     199         0.794         3.700         3.500
JUL     505         1.404         4.500         4.100
AUG     235         1.181         3.000         2.900
OCT      24         0.971         1.300         1.200
NOV     310         1.139        14.800        13.000
DEC     548         0.791         5.000         4.500
ANN    3014         0.768        14.800        13.000

                    ANNUAL DIURNAL TRENDS (CST)
HR     MEAN          HR    MEAN             HR    MEAN

 0     1.060          8    0.833            16    0.564
 1     1.011          9    0.608            17    0.695
 2     1.059         10    0.571            18    0.859
 3     1.022         11    0.549            19    0.998
 4     0.989         12    0.482            20    1.064
 5     1.120         13    0.526            21    1.224
 6     1.153         14    0.517            22    1.236
 7     0.977         15    0.468            23    1.122
```

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MAE DRIVE  1975          NMHC    (PPM)

       #OBS          MEAN          MAX          2ND MAX

MAR     479          0.655         3.800         2.900
APR     252          0.730         2.500         2.500
MAY      11          0.791         2.300         1.000
JUN      13          1.292         3.600         3.300
JUL     517          0.877         3.800         3.500
AUG     317          0.949         3.600         3.500
SEP     386          1.069         5.200         4.500
OCT     315          1.217         4.100         4.100
NOV     311          0.846         4.100         3.800
DEC     483          0.829         4.600         4.300
ANN    3084          0.926         5.200         4.600

                    ANNUAL DIURNAL TRENDS (CST)
HR      MEAN          HR     MEAN            HR      MEAN

 0      1.135          8     0.852           16      0.600
 1      1.056          9     0.699           17      0.715
 2      0.996         10     0.653           18      0.911
 3      0.948         11     0.568           19      1.041
 4      0.932         12     0.553           20      1.125
 5      1.026         13     0.546           21      1.148
 6      1.136         14     0.556           22      1.145
 7      1.055         15     0.577           23      1.139
```

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MAE DRIVE  1976          NMHC    (PPM)

         #OBS          MEAN          MAX          2ND MAX

JAN       150          0.711         2.900        2.500
MAR       561          0.776         3.500        3.200
APR       592          0.840         3.900        3.700
MAY       570          0.859         5.400        4.100
JUN       421          1.001         3.800        3.700
JUL       465          1.112         5.000        4.400
AUG       433          1.074         4.800        4.600
SEP       470          1.158         6.500        4.700
OCT       695          1.192         5.100        5.100
NOV       495          1.404         6.100        5.900
DEC       541          1.229         5.600        5.300
ANN      5393          1.031         6.500        6.100

                    ANNUAL DIURNAL TRENDS (CST)
HR     MEAN            HR    MEAN             HR     MEAN

 0     1.295            8    1.017            16     0.820
 1     1.222            9    0.906            17     0.851
 2     1.145           10    0.900            18     0.953
 3     1.138           11    0.916            19     1.094
 4     1.160           12    0.798            20     1.218
 5     1.200           13    0.736            21     1.233
 6     1.277           14    0.752            22     1.239
 7     1.153           15    0.704            23     1.254
```

MAE DRIVE 1977 NMHC (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	553	0.854	5.000	4.300
FEB	518	0.698	4.300	4.000
MAR	587	0.835	4.400	4.400
APR	538	0.939	4.200	3.500
MAY	441	1.421	7.100	6.500
JUL	545	0.832	4.300	3.600
AUG	418	1.600	7.200	5.800
SEP	483	1.165	7.000	6.300
OCT	545	1.442	6.100	6.000
ANN	4628	1.087	7.200	7.100

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	1.321	8	1.046	16	0.725
1	1.315	9	0.797	17	0.797
2	1.256	10	0.777	18	0.938
3	1.250	11	0.696	19	1.116
4	1.359	12	0.641	20	1.159
5	1.409	13	0.656	21	1.278
6	1.535	14	0.676	22	1.323
7	1.416	15	0.655	23	1.251

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MAE DRIVE   ALL YEARS     NMHC    (PPM)

        #OBS          MEAN          MAX           2ND MAX

JAN    751.           0.794          5.000          4.300
FEB    691.           0.576          4.300          4.000
MAR   1897.           0.676          4.400          4.400
APR   1504.           0.831          4.200          3.900
MAY   1602.           1.026         10.900          9.300
JUN    982.           0.735          7.500          5.000
JUL   2476.           1.034          5.000          4.500
AUG   1490.           1.199          7.200          5.800
SEP   1558.           1.017          7.000          6.500
OCT   1643.           1.241          6.100          6.000
NOV   1328.           1.053         14.800         13.000
DEC   1800.           0.911          5.600          5.300
ANN  17722.           0.924         14.800         13.000

                   ANNUAL DIURNAL TRENDS (CST)
HR     MEAN           HR    MEAN             HR     MEAN

 0     1.180           8    0.948            16     0.674
 1     1.134           9    0.766            17     0.747
 2     1.111          10    0.726            18     0.885
 3     1.081          11    0.686            19     1.024
 4     1.094          12    0.615            20     1.108
 5     1.167          13    0.605            21     1.178
 6     1.252          14    0.619            22     1.194
 7     1.125          15    0.599            23     1.156
```

```
MAE DRIVE  1973          SO2   (PPM)

        #OBS           MEAN           MAX           2ND MAX

APR      105           0.000          0.000          0.000
MAY      368           0.000          0.000          0.000
JUN      487           0.000          0.010          0.010
JUL      486           0.000          0.030          0.020
AUG      270           0.001          0.060          0.050
SEP      454           0.001          0.040          0.040
OCT      386           0.002          0.090          0.050
NOV      242           0.000          0.030          0.020
DEC      222           0.003          0.100          0.080
ANN     3022           0.001          0.100          0.090

                       ANNUAL DIURNAL TRENDS (CST)
HR      MEAN               HR     MEAN              HR     MEAN

 0      0.000               8     0.001             16     0.000
 1      0.000               9     0.002             17     0.002
 2      0.000              10     0.001             18     0.001
 3      0.000              11     0.000             19     0.002
 4      0.000              12     0.000             20     0.002
 5      0.000              13     0.001             21     0.002
 6      0.000              14     0.000             22     0.001
 7      0.000              15     0.001             23     0.002
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MAE DRIVE  1974          SO2   (PPM)

        #OBS          MEAN          MAX           2ND MAX

MAR      182          0.000         0.040         0.020
APR      112          0.001         0.020         0.020
MAY      463          0.000         0.000         0.000
JUN      454          0.000         0.000         0.000
JUL      556          0.000         0.000         0.000
AUG      223          0.000         0.000         0.000
SEP      115          0.000         0.000         0.000
OCT      457          0.003         0.180         0.120
NOV      389          0.003         0.170         0.150
DEC      498          0.005         0.270         0.210
ANN     3449          0.001         0.270         0.210

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR     MEAN             HR      MEAN

 0      0.000            8     0.003            16      0.001
 1      0.000            9     0.005            17      0.002
 2      0.000           10     0.002            18      0.002
 3      0.000           11     0.002            19      0.003
 4      0.000           12     0.003            20      0.003
 5      0.000           13     0.002            21      0.002
 6      0.001           14     0.001            22      0.002
 7      0.002           15     0.002            23      0.000
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MAE DRIVE  1975          SO2   (PPM)

      #OBS        MEAN          MAX          2ND MAX

MAR    125       0.000         0.010         0.000
APR    158       0.000         0.000         0.000
MAY    186       0.000         0.000         0.000
JUN    380       0.000         0.000         0.000
JUL    209       0.000         0.010         0.010
AUG    619       0.000         0.150         0.110
SEP    526       0.001         0.130         0.050
OCT    507       0.006         0.170         0.160
NOV    525       0.003         0.200         0.160
DEC    541       0.004         0.140         0.130
ANN   3776       0.001         0.200         0.170

                  ANNUAL DIURNAL TRENDS (CST)
HR    MEAN         HR    MEAN          HR    MEAN

 0    0.004         8    0.002         16    0.001
 1    0.002         9    0.004         17    0.003
 2    0.001        10    0.002         18    0.002
 3    0.001        11    0.004         19    0.001
 4    0.001        12    0.002         20    0.002
 5    0.001        13    0.004         21    0.002
 6    0.001        14    0.002         22    0.002
 7    0.002        15    0.000         23    0.002
```

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MAE DRIVE  1976          SO2    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN      242          0.002         0.100         0.080
FEB      291          0.000         0.010         0.000
MAR      216          0.000         0.010         0.010
APR      590          0.000         0.040         0.010
MAY      659          0.000         0.120         0.050
JUN      303          0.000         0.000         0.000
JUL       15          0.000         0.000         0.000
AUG      429          0.000         0.000         0.000
SEP      438          0.000         0.000         0.000
OCT      604          0.000         0.010         0.010
NOV      261          0.003         0.080         0.080
DEC      592          0.003         0.090         0.080
ANN     4640          0.000         0.120         0.100

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR     MEAN            HR      MEAN

 0      0.000             8     0.000           16      0.001
 1      0.000             9     0.001           17      0.000
 2      0.000            10     0.001           18      0.001
 3      0.000            11     0.002           19      0.000
 4      0.000            12     0.000           20      0.001
 5      0.000            13     0.000           21      0.001
 6      0.000            14     0.001           22      0.001
 7      0.000            15     0.001           23      0.000
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MAE DRIVE  1977          SO2    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN      552          0.002        0.100         0.060
FEB      509          0.003        0.090         0.080
MAR      589          0.001        0.030         0.030
APR      386          0.002        0.040         0.030
MAY      507          0.000        0.010         0.010
JUN      473          0.001        0.020         0.020
JUL      356          0.001        0.010         0.010
AUG      605          0.000        0.010         0.000
SEP      630          0.000        0.030         0.000
OCT      564          0.000        0.020         0.020
ANN     5171          0.000        0.100         0.090

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR     MEAN            HR      MEAN

 0      0.000             8     0.001           16      0.001
 1      0.000             9     0.001           17      0.000
 2      0.000            10     0.000           18      0.001
 3      0.000            11     0.000           19      0.001
 4      0.001            12     0.000           20      0.001
 5      0.000            13     0.001           21      0.001
 6      0.001            14     0.000           22      0.001
 7      0.000            15     0.000           23      0.001
```

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MAE DRIVE  ALL YEARS    SO2   (PPM)

       #OBS          MEAN          MAX           2ND MAX

JAN    794.          0.002         0.100         0.100
FEB    800.          0.002         0.090         0.080
MAR   1112.          0.000         0.040         0.030
APR   1351.          0.001         0.040         0.040
MAY   2183.          0.000         0.120         0.050
JUN   2097.          0.000         0.020         0.020
JUL   1624.          0.000         0.030         0.020
AUG   2146.          0.000         0.150         0.110
SEP   2163.          0.000         0.130         0.050
OCT   2518.          0.002         0.180         0.170
NOV   1417.          0.003         0.200         0.170
DEC   1853.          0.004         0.270         0.210
ANN  20058.          0.001         0.270         0.210

                     ANNUAL DIURNAL TRENDS (CST)
HR     MEAN             HR    MEAN             HR    MEAN

 0     0.001             8    0.001            16    0.001
 1     0.000             9    0.003            17    0.002
 2     0.000            10    0.001            18    0.001
 3     0.001            11    0.002            19    0.001
 4     0.000            12    0.002            20    0.002
 5     0.000            13    0.001            21    0.002
 6     0.000            14    0.001            22    0.001
 7     0.001            15    0.001            23    0.001
```

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MAE DRIVE  1973          CO    (PPM)

        #OBS          MEAN           MAX           2ND MAX

JUN      556          0.984          3.800          3.500
JUL      302          1.707          7.800          5.300
AUG      150          1.928          4.100          3.900
SEP      190          1.042          3.400          3.000
OCT      173          1.284          5.000          4.900
NOV      134          1.309         10.300          9.000
DEC      541          2.101          8.300          8.000
ANN     2046          1.479         10.300          9.000

                      ANNUAL DIURNAL TRENDS (CST)
HR       MEAN            HR     MEAN              HR      MEAN

 0       1.497            8     1.591             16      1.389
 1       1.453            9     1.253             17      1.551
 2       1.305           10     1.263             18      1.732
 3       1.283           11     1.185             19      1.811
 4       1.268           12     1.188             20      1.759
 5       1.568           13     1.196             21      1.787
 6       1.981           14     1.248             22      1.773
 7       1.906           15     1.331             23      1.631
```

```
MAE DRIVE  1974          CO    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN      305          2.157        10.700          6.500
FEB      197          1.148         6.000          4.700
MAR      596          0.952         8.600          6.000
APR      178          1.365         6.100          5.500
MAY      595          1.229         5.300          3.800
JUN      349          1.319         5.500          5.200
JUL      505          1.823         6.200          5.900
AUG      235          2.054         5.100          5.100
OCT       24          2.783         3.000          3.000
NOV      310          2.691        12.600         12.200
DEC      548          2.394         9.300          9.300
ANN     3842          1.810        12.600         12.200

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR     MEAN            HR      MEAN

 0      1.785            8     1.855           16      1.503
 1      1.664            9     1.493           17      1.643
 2      1.623           10     1.381           18      1.707
 3      1.554           11     1.393           19      1.799
 4      1.555           12     1.407           20      1.838
 5      1.862           13     1.426           21      1.851
 6      2.246           14     1.551           22      1.896
 7      2.141           15     1.467           23      1.848
```

```
MAE DRIVE  1975          CO    (PPM)

        #OBS          MEAN          MAX          2ND MAX

MAR     479          0.699        11.400          9.000
APR     252          0.576         2.500          2.400
MAY      11          1.218         5.100          1.600
JUN      13          1.000         3.400          2.800
JUL     521          0.845         6.600          5.300
AUG     318          0.831         3.500          3.100
SEP     386          0.847         8.000          7.500
OCT     318          1.008         7.200          6.200
NOV     311          1.150         7.000          6.800
DEC     482          0.128         4.800          4.100
ANN    3091          0.830        11.400          9.000

                     ANNUAL DIURNAL TRENDS (CST)
HR      MEAN           HR     MEAN              HR     MEAN

 0      0.762           8     0.898             16     0.553
 1      0.618           9     0.521             17     0.617
 2      0.574          10     0.483             18     0.708
 3      0.499          11     0.392             19     0.795
 4      0.567          12     0.370             20     0.873
 5      1.069          13     0.395             21     0.904
 6      1.649          14     0.457             22     0.905
 7      1.519          15     0.466             23     0.899
```

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MAE DRIVE  1976          CO    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN      150          0.039         2.500         1.800
MAR      561          0.530         5.200         4.900
APR      592          0.560         5.700         4.500
MAY      570          0.633         6.200         5.000
JUN      421          0.480         3.100         3.000
JUL      465          0.460         5.000         4.600
AUG      433          0.666         3.600         3.400
SEP      460          0.852         7.500         6.000
OCT      695          0.930         7.200         5.400
NOV      517          0.935         7.400         6.200
DEC      560          1.227         8.600         8.600
ANN     5424          0.665         8.600         8.600

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN              HR      MEAN               HR      MEAN

 0      0.746              8      0.984              16      0.545
 1      0.662              9      0.610              17      0.615
 2      0.557             10      0.486              18      0.716
 3      0.435             11      0.489              19      0.814
 4      0.484             12      0.456              20      0.838
 5      0.895             13      0.431              21      0.894
 6      1.366             14      0.517              22      0.881
 7      1.353             15      0.522              23      0.860
```

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MAE DRIVE  1977          CO    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN      562          1.035        14.100        12.500
FEB      527          0.856         9.600         9.400
MAR      590          0.790         9.700         8.100
APR      524          0.873         9.000         8.100
MAY      428          0.486         3.200         3.000
JUL      546          0.594         4.800         4.800
AUG      401          0.469         4.100         3.500
SEP      303          0.396         6.700         2.800
OCT      460          0.660         7.900         7.000
ANN     4341          0.684        14.100        12.500

                     ANNUAL DIURNAL TRENDS (CST)
HR      MEAN              HR     MEAN              HR     MEAN

 0      0.712              8     1.164             16     0.544
 1      0.637              9     0.588             17     0.597
 2      0.582             10     0.490             18     0.671
 3      0.557             11     0.437             19     0.762
 4      0.553             12     0.422             20     0.771
 5      0.898             13     0.374             21     0.751
 6      1.488             14     0.451             22     0.758
 7      1.583             15     0.485             23     0.752
```

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MAE DRIVE  ALL YEARS    CO   (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN  1017.           1.225        14.100         12.500
FEB   724.           0.935         9.600          9.400
MAR  2226.           0.749        11.400          9.700
APR  1546.           0.761         9.000          8.100
MAY  1604.           0.819         6.200          5.300
JUN  1339.           0.913         5.500          5.200
JUL  2339.           1.032         7.800          6.600
AUG  1537.           0.984         5.100          5.100
SEP  1339.           0.774         8.000          7.500
OCT  1670.           0.934         7.900          7.200
NOV  1272.           1.455        12.600         12.200
DEC  2131.           1.501         9.300          9.300
ANN 18744.           1.007        14.100         12.600

                    ANNUAL DIURNAL TRENDS (CST)
HR     MEAN            HR    MEAN             HR     MEAN

 0     1.039            8    1.226            16     0.834
 1     0.947            9    0.814            17     0.925
 2     0.869           10    0.751            18     1.018
 3     0.799           11    0.733            19     1.110
 4     0.823           12    0.724            20     1.136
 5     1.201           13    0.721            21     1.159
 6     1.692           14    0.775            22     1.163
 7     1.658           15    0.780            23     1.130
```

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TEXAS CITY  1974          OZONE (PPM)

       #OBS          MEAN          MAX           2ND MAX

JUN     255          0.033         0.096         0.096
JUL     463          0.030         0.277         0.234
AUG     407          0.027         0.115         0.114
SEP     194          0.034         0.069         0.066
ANN    1319          0.031         0.277         0.234

                     ANNUAL DIURNAL TRENDS (CST)
HR     MEAN             HR     MEAN              HR     MEAN

 0     0.022             8     0.029             16     0.042
 1     0.022             9     0.036             17     0.034
 2     0.021            10     0.043             18     0.028
 3     0.019            11     0.049             19     0.024
 4     0.016            12     0.053             20     0.024
 5     0.014            13     0.056             21     0.023
 6     0.014            14     0.049             22     0.022
 7     0.021            15     0.048             23     0.021
```

TEXAS CITY 1975 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	499	0.023	0.120	0.085
FEB	581	0.026	0.145	0.105
MAR	333	0.027	0.125	0.123
APR	639	0.041	0.105	0.103
MAY	490	0.038	0.149	0.144
JUN	332	0.027	0.108	0.102
JUL	314	0.020	0.128	0.093
AUG	595	0.026	0.120	0.119
SEP	601	0.045	0.222	0.193
OCT	620	0.040	0.144	0.126
NOV	575	0.034	0.141	0.128
DEC	659	0.019	0.082	0.081
ANN	6238	0.031	0.222	0.193

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.026	8	0.029	16	0.042
1	0.026	9	0.035	17	0.035
2	0.025	10	0.041	18	0.029
3	0.024	11	0.044	19	0.026
4	0.023	12	0.047	20	0.025
5	0.022	13	0.048	21	0.025
6	0.018	14	0.048	22	0.026
7	0.021	15	0.046	23	0.027

TEXAS CITY 1976   OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	421	0.019	0.073	0.065
FEB	584	0.019	0.086	0.080
MAR	544	0.027	0.095	0.090
APR	377	0.042	0.147	0.131
MAY	507	0.039	0.136	0.136
JUN	452	0.030	0.122	0.119
JUL	583	0.024	0.193	0.184
AUG	369	0.040	0.183	0.173
SEP	637	0.044	0.225	0.197
OCT	572	0.037	0.203	0.168
NOV	626	0.026	0.197	0.160
DEC	469	0.025	0.138	0.114
ANN	6141	0.031	0.225	0.203

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.024	8	0.029	16	0.043
1	0.023	9	0.036	17	0.035
2	0.021	10	0.043	18	0.028
3	0.021	11	0.047	19	0.025
4	0.021	12	0.050	20	0.023
5	0.019	13	0.053	21	0.024
6	0.017	14	0.051	22	0.023
7	0.021	15	0.047	23	0.024

TEXAS CITY 1977 OZONE (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	538	0.019	0.085	0.073
FEB	502	0.012	0.052	0.041
MAR	137	0.028	0.071	0.067
APR	77	0.050	0.101	0.101
MAY	595	0.041	0.165	0.159
JUN	666	0.031	0.236	0.202
JUL	369	0.020	0.078	0.076
AUG	625	0.022	0.101	0.098
SEP	669	0.025	0.199	0.197
OCT	568	0.039	0.221	0.180
ANN	4746	0.029	0.236	0.221

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.022	8	0.025	16	0.035
1	0.022	9	0.031	17	0.031
2	0.021	10	0.036	18	0.026
3	0.021	11	0.036	19	0.024
4	0.019	12	0.041	20	0.023
5	0.017	13	0.042	21	0.023
6	0.015	14	0.042	22	0.023
7	0.019	15	0.039	23	0.022

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TEXAS CITY  ALL YEARS    OZONE (PPM)

       #OBS          MEAN          MAX          2ND MAX

JAN   1458.         0.020         0.120         0.085
FEB   1667.         0.019         0.145         0.105
MAR   1014.         0.027         0.125         0.123
APR   1093.         0.042         0.147         0.131
MAY   1592.         0.039         0.165         0.159
JUN   1705.         0.030         0.236         0.202
JUL   1729.         0.024         0.277         0.234
AUG   1996.         0.028         0.183         0.173
SEP   2101.         0.037         0.225         0.222
OCT   1760.         0.039         0.221         0.203
NOV   1201.         0.030         0.197         0.160
DEC   1128.         0.021         0.136         0.114
ANN  18444.         0.030         0.277         0.236

                    ANNUAL DIURNAL TRENDS (CST)
HR     MEAN          HR    MEAN             HR     MEAN

 0     0.024          8    0.028            16     0.041
 1     0.024          9    0.034            17     0.034
 2     0.022         10    0.040            18     0.028
 3     0.022         11    0.044            19     0.025
 4     0.021         12    0.047            20     0.024
 5     0.019         13    0.049            21     0.024
 6     0.017         14    0.048            22     0.024
 7     0.021         15    0.045            23     0.024
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TEXAS CITY  1975          NOX    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JUN      460          0.017        0.130         0.130
JUL      634          0.011        0.070         0.070
AUG      525          0.011        0.080         0.080
SEP      119          0.004        0.030         0.030
NOV      388          0.025        0.210         0.160
DEC      601          0.025        0.300         0.160
ANN     2727          0.015        0.300         0.210

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR     MEAN              HR     MEAN

 0      0.017             8     0.017             16     0.016
 1      0.013             9     0.014             17     0.018
 2      0.012            10     0.013             18     0.022
 3      0.012            11     0.012             19     0.024
 4      0.013            12     0.012             20     0.024
 5      0.016            13     0.011             21     0.022
 6      0.024            14     0.013             22     0.021
 7      0.021            15     0.014             23     0.019
```

```
TEXAS CITY  1976          NOX    (PPM)

        #OBS          MEAN          MAX           2ND MAX

JAN      659          0.029         0.490         0.430
FEB      657          0.034         0.160         0.140
MAR      633          0.023         0.290         0.110
APR      644          0.022         0.090         0.080
MAY      184          0.030         0.120         0.110
JUN      168          0.024         0.200         0.170
JUL      335          0.018         0.070         0.070
AUG      521          0.015         0.320         0.300
SEP       59          0.020         0.320         0.220
OCT      557          0.015         0.160         0.150
NOV      314          0.027         0.430         0.370
DEC      625          0.052         0.710         0.420
ANN     5356          0.026         0.710         0.490

                      ANNUAL  DIURNAL  TRENDS  (CST)
HR      MEAN            HR      MEAN              HR      MEAN

 0      0.024            8      0.030             16      0.023
 1      0.023            9      0.022             17      0.028
 2      0.024           10      0.020             18      0.034
 3      0.025           11      0.020             19      0.038
 4      0.022           12      0.019             20      0.039
 5      0.025           13      0.020             21      0.036
 6      0.031           14      0.023             22      0.031
 7      0.037           15      0.022             23      0.025
```

```
TEXAS CITY  1977          NOX    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN      498          0.025         0.180         0.170
FEB      178          0.020         0.150         0.120
MAR      629          0.027         0.220         0.140
APR      524          0.025         0.160         0.180
MAY      313          0.026         0.060         0.060
JUN      670          0.028         0.110         0.080
JUL      692          0.025         0.080         0.070
AUG      166          0.018         0.070         0.050
SEP      669          0.022         0.100         0.080
OCT      569          0.028         0.210         0.190
ANN     4908          0.024         0.220         0.210

                    ANNUAL DIURNAL TRENDS (CST)
HR     MEAN           HR    MEAN              HR     MEAN

 0     0.026           8    0.025             16     0.025
 1     0.024           9    0.020             17     0.026
 2     0.023          10    0.019             18     0.030
 3     0.021          11    0.019             19     0.033
 4     0.021          12    0.019             20     0.033
 5     0.024          13    0.019             21     0.032
 6     0.033          14    0.019             22     0.030
 7     0.033          15    0.021             23     0.028
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TEXAS CITY  ALL YEARS    NOX    (PPM)

       #OBS          MEAN          MAX           2ND MAX

JAN   1157.          0.027         0.490         0.430
FEB    835.          0.031         0.160         0.150
MAR   1262.          0.025         0.290         0.220
APR   1168.          0.024         0.180         0.180
MAY    497.          0.027         0.120         0.110
JUN   1298.          0.024         0.200         0.170
JUL   1661.          0.018         0.080         0.070
AUG   1212.          0.014         0.320         0.300
SEP    847.          0.020         0.320         0.220
OCT   1126.          0.022         0.210         0.190
NOV    702.          0.026         0.430         0.370
DEC   1226.          0.039         0.710         0.420
ANN  12991.          0.025         0.710         0.490

                     ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR     MEAN             HR      MEAN

 0      0.023            8     0.026            16      0.022
 1      0.022            9     0.019            17      0.025
 2      0.021           10     0.018            18      0.030
 3      0.020           11     0.018            19      0.033
 4      0.020           12     0.018            20      0.033
 5      0.023           13     0.018            21      0.032
 6      0.031           14     0.019            22      0.028
 7      0.032           15     0.020            23      0.025
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TEXAS CITY  1974          NMHC    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JUN      219          1.580         3.000         3.000
JUL      487          1.255         4.900         3.700
NOV      392          0.469         4.800         3.100
DEC      461          0.952         7.200         4.400
ANN     1559          1.064         7.200         4.900

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR     MEAN              HR     MEAN

 0      1.164            8     0.895             16     0.940
 1      1.029            9     0.854             17     0.957
 2      1.093           10     0.834             18     1.123
 3      1.038           11     0.786             19     1.255
 4      1.067           12     0.784             20     1.141
 5      1.041           13     0.784             21     1.259
 6      0.979           14     0.759             22     1.367
 7      0.950           15     0.874             23     1.193
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TEXAS CITY  1975          NMHC    (PPM)

        #OBS          MEAN          MAX           2ND MAX

JAN      302          0.920         5.100          4.300
FEB      420          1.040         6.400          5.700
MAR      265          1.043         3.700          3.300
APR      351          0.429         1.800          1.700
MAY       24          0.092         0.600          0.500
JUN      232          0.837         3.900          3.600
JUL      413          0.823         2.900          2.800
AUG      434          0.874         4.900          4.800
SEP      515          0.653         4.000          2.900
OCT      296          0.810         5.600          4.600
NOV      492          1.882         6.000          5.800
DEC      422          0.870         3.800          3.800
ANN     4166          0.856         6.400          6.000

                   ANNUAL  DIURNAL  TRENDS  (CST)
HR      MEAN          HR     MEAN                HR      MEAN

 0      1.050          8     0.885               16      0.835
 1      0.993          9     0.879               17      0.834
 2      0.994         10     0.808               18      0.959
 3      0.984         11     0.797               19      1.001
 4      1.000         12     0.795               20      1.005
 5      1.020         13     0.844               21      1.023
 6      1.088         14     0.762               22      1.078
 7      1.024         15     0.817               23      1.045
```

TEXAS CITY 1976 NMHC (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	185	0.913	4.200	4.100
FEB	232	1.437	4.400	3.600
MAR	369	0.681	3.700	3.300
APR	517	0.738	3.600	3.600
MAY	648	0.701	3.500	2.800
JUN	282	0.763	2.600	2.600
OCT	498	1.174	5.500	5.400
NOV	414	0.659	6.400	6.200
DEC	69	1.116	3.200	3.100
ANN	3214	0.909	6.400	6.200

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.929	8	0.763	16	0.701
1	0.964	9	0.666	17	0.765
2	0.957	10	0.698	18	0.911
3	0.960	11	0.710	19	1.013
4	0.935	12	0.639	20	1.035
5	0.882	13	0.602	21	1.001
6	0.947	14	0.657	22	0.974
7	0.951	15	0.667	23	0.954

```
TEXAS CITY  1977          NMHC    (PPM)

       #OBS          MEAN          MAX          2ND MAX

JAN      28          0.582         0.900         0.900
APR      23          0.365         1.100         0.900
MAY     435          0.633         3.600         2.300
JUN     354          0.659         2.600         2.200
JUL     688          0.728         3.600         3.300
AUG     491          0.589         3.600         3.000
SEP     478          0.825         3.600         3.300
OCT     475          0.700         5.300         3.900
ANN    2972          0.635         5.300         3.900

                    ANNUAL DIURNAL TRENDS (CST)
HR     MEAN           HR     MEAN             HR     MEAN

 0     0.845           8     0.541            16     0.606
 1     0.847           9     0.470            17     0.625
 2     0.869          10     0.513            18     0.661
 3     0.752          11     0.541            19     0.754
 4     0.725          12     0.551            20     0.747
 5     0.840          13     0.505            21     0.801
 6     0.856          14     0.515            22     0.801
 7     0.697          15     0.570            23     0.801
```

```
TEXAS CITY  ALL YEARS    NMHC    (PPM)

       #OBS          MEAN          MAX           2ND MAX

JAN    515.          0.899         5.100         4.300
FEB    652.          1.182         6.400         5.700
MAR    634.          0.832         3.700         3.700
APR    891.          0.607         3.600         3.600
MAY   1107.          0.661         3.600         3.500
JUN   1087.          0.909         3.900         3.600
JUL   1588.          0.914         4.900         3.700
AUG    925.          0.723         4.900         4.800
SEP    993.          0.736         4.000         3.600
OCT   1269.          0.912         5.600         5.500
NOV   1298.          1.065         6.400         6.200
DEC    952.          0.928         7.200         4.400
ANN  11911.          0.864         7.200         6.400

                     ANNUAL DIURNAL TRENDS (CST)
HR     MEAN             HR    MEAN             HR     MEAN

 0     0.981             8    0.770            16     0.756
 1     0.953             9    0.714            17     0.781
 2     0.966            10    0.705            18     0.895
 3     0.926            11    0.707            19     0.977
 4     0.922            12    0.692            20     0.966
 5     0.940            13    0.684            21     0.993
 6     0.978            14    0.669            22     1.019
 7     0.914            15    0.721            23     0.980
```

```
TEXAS CITY  1974          S02    (PPM)

       #OBS          MEAN          MAX          2ND MAX

JUN     208          0.000         0.020         0.010
JUL      92          0.000         0.000         0.000
AUG     193          0.000         0.000         0.000
SEP      32          0.000         0.000         0.000
NOV     316          0.001         0.020         0.020
DEC      39          0.000         0.000         0.000
ANN     880          0.000         0.020         0.020

                     ANNUAL DIURNAL TRENDS (CST)
HR     MEAN              HR    MEAN               HR     MEAN

 0     0.000              8    0.000              16     0.000
 1     0.001              9    0.001              17     0.000
 2     0.000             10    0.002              18     0.000
 3     0.001             11    0.000              19     0.000
 4     0.000             12    0.000              20     0.001
 5     0.000             13    0.000              21     0.000
 6     0.001             14    0.001              22     0.001
 7     0.000             15    0.001              23     0.001
```

```
TEXAS CITY  1975          S02    (PPM)

         #OBS          MEAN           MAX          2ND MAX

FEB       125          0.003          0.070          0.060
MAR       314          0.000          0.000          0.000
APR       424          0.000          0.000          0.000
MAY        73          0.000          0.050          0.000
JUN       116          0.003          0.060          0.040
JUL       337          0.000          0.000          0.000
AUG       559          0.000          0.000          0.000
SEP       601          0.000          0.000          0.000
OCT       602          0.000          0.000          0.000
NOV       501          0.000          0.210          0.130
DEC       524          0.000          0.010          0.000
ANN      4176          0.000          0.210          0.130

                       ANNUAL DIURNAL TRENDS (CST)
HR       MEAN             HR     MEAN              HR      MEAN

 0       0.000             8     0.000             16      0.000
 1       0.000             9     0.000             17      0.000
 2       0.000            10     0.000             18      0.000
 3       0.000            11     0.000             19      0.000
 4       0.001            12     0.000             20      0.000
 5       0.002            13     0.000             21      0.000
 6       0.000            14     0.000             22      0.000
 7       0.000            15     0.000             23      0.000
```

```
TEXAS CITY  1976          S02    (PPM)

        #OBS          MEAN          MAX          2ND MAX

JAN      663          0.000         0.020         0.020
FEB      656          0.000         0.020         0.020
MAR      633          0.000         0.000         0.000
APR      551          0.000         0.020         0.020
MAY      441          0.000         0.000         0.000
JUN      354          0.010         0.310         0.230
JUL      500          0.000         0.070         0.040
AUG       83          0.000         0.020         0.000
SEP      567          0.000         0.010         0.000
OCT      557          0.000         0.000         0.000
NOV      372          0.000         0.150         0.020
DEC      160          0.000         0.000         0.000
ANN     5537          0.000         0.310         0.230

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR     MEAN            HR      MEAN

 0      0.002            8     0.000           16      0.000
 1      0.001            9     0.000           17      0.002
 2      0.001           10     0.000           18      0.002
 3      0.000           11     0.000           19      0.002
 4      0.000           12     0.000           20      0.002
 5      0.000           13     0.000           21      0.002
 6      0.000           14     0.000           22      0.000
 7      0.000           15     0.000           23      0.001
```

```
TEXAS CITY  1977          S02   (PPM)

        #OBS          MEAN         MAX          2ND MAX

JAN      406          0.000        0.020        0.010
FEB      560          0.000        0.010        0.010
MAR      310          0.001        0.030        0.020
APR      135          0.000        0.000        0.000
MAY       75          0.000        0.000        0.000
JUN      370          0.000        0.010        0.010
JUL      480          0.000        0.000        0.000
AUG      378          0.000        0.000        0.000
SEP      275          0.000        0.000        0.000
OCT      279          0.000        0.000        0.000
ANN     3268          0.000        0.030        0.020

                     ANNUAL DIURNAL TRENDS (CST)
HR      MEAN            HR    MEAN            HR     MEAN

 0      0.000            8    0.000           16     0.000
 1      0.000            9    0.000           17     0.000
 2      0.000           10    0.000           18     0.000
 3      0.000           11    0.000           19     0.000
 4      0.000           12    0.000           20     0.000
 5      0.000           13    0.000           21     0.000
 6      0.000           14    0.000           22     0.000
 7      0.000           15    0.000           23     0.000
```

```
TEXAS CITY  ALL YEARS    SO2   (PPM)

      #OBS         MEAN         MAX          2ND MAX

JAN  1069.         0.000        0.020        0.020
FEB  1341.         0.000        0.070        0.060
MAR  1257.         0.000        0.030        0.020
APR  1110.         0.000        0.020        0.020
MAY   589.         0.000        0.050        0.000
JUN  1048.         0.004        0.310        0.230
JUL  1409.         0.000        0.070        0.040
AUG  1213.         0.000        0.020        0.000
SEP  1475.         0.000        0.010        0.000
OCT  1438.         0.000        0.000        0.000
NOV  1189.         0.000        0.210        0.150
DEC   723.         0.000        0.010        0.000
ANN 13861.         0.000        0.310        0.230

                   ANNUAL DIURNAL TRENDS (CST)
HR     MEAN            HR     MEAN            HR     MEAN

 0     0.000            8     0.000           16     0.000
 1     0.000            9     0.000           17     0.000
 2     0.000           10     0.000           18     0.000
 3     0.000           11     0.000           19     0.000
 4     0.001           12     0.000           20     0.000
 5     0.001           13     0.000           21     0.000
 6     0.000           14     0.000           22     0.000
 7     0.000           15     0.000           23     0.001
```

TEXAS CITY 1974 CO (PPM)

	#OBS	MEAN	MAX	2ND MAX
JUN	219	0.436	1.600	1.300
JUL	487	0.410	1.500	1.200
NOV	396	1.137	7.800	5.600
DEC	465	0.604	6.000	4.500
ANN	1567	0.647	7.800	6.000

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.624	8	0.665	16	0.655
1	0.585	9	0.612	17	0.726
2	0.554	10	0.571	18	0.871
3	0.540	11	0.541	19	0.890
4	0.531	12	0.528	20	0.828
5	0.578	13	0.538	21	0.804
6	0.634	14	0.578	22	0.810
7	0.671	15	0.589	23	0.729

```
TEXAS CITY  1975          CO    (PPM)

        #OBS          MEAN          MAX           2ND MAX

JAN      302          0.693         3.800         3.400
FEB      420          0.575         3.000         2.800
MAR      265          0.506         2.800         2.200
APR      351          0.239         2.100         1.900
MAY       24          0.054         0.200         0.200
JUN      234          0.221         3.400         2.100
JUL      413          0.115         0.900         0.900
AUG      409          0.168         1.300         1.100
SEP      516          0.177         3.100         2.400
OCT      297          0.388         3.000         2.400
NOV      500          0.325         3.300         2.700
DEC      426          0.310         2.500         2.200
ANN     4157          0.314         3.800         3.400

                      ANNUAL DIURNAL TRENDS (CST)
HR      MEAN             HR    MEAN             HR      MEAN

 0      0.354             8    0.345            16      0.330
 1      0.288             9    0.260            17      0.370
 2      0.238            10    0.242            18      0.434
 3      0.217            11    0.223            19      0.462
 4      0.235            12    0.263            20      0.439
 5      0.232            13    0.249            21      0.402
 6      0.382            14    0.276            22      0.336
 7      0.425            15    0.335            23      0.337
```

TEXAS CITY 1976 CO (PPM)

	#OBS	MEAN	MAX	2ND MAX
JAN	165	0.398	6.000	4.400
FEB	232	0.302	2.300	2.000
MAR	369	0.250	5.100	1.500
APR	517	0.258	1.500	1.300
MAY	648	0.285	1.600	1.500
JUN	282	0.288	2.100	2.100
OCT	498	0.063	1.400	1.200
NOV	414	0.237	5.500	4.800
DEC	69	0.180	1.600	1.000
ANN	3214	0.251	6.000	5.500

ANNUAL DIURNAL TRENDS (CST)

HR	MEAN	HR	MEAN	HR	MEAN
0	0.174	8	0.255	16	0.220
1	0.165	9	0.158	17	0.301
2	0.184	10	0.147	18	0.378
3	0.153	11	0.136	19	0.449
4	0.160	12	0.131	20	0.406
5	0.181	13	0.144	21	0.425
6	0.275	14	0.170	22	0.329
7	0.328	15	0.202	23	0.251

```
TEXAS CITY  1977          CO    (PPM)

       #OBS          MEAN          MAX          2ND MAX

JAN      28          0.271         1.000         0.900
APR      23          0.674         4.800         4.700
MAY     429          0.336         1.500         1.100
JUN     351          0.351         1.600         1.500
JUL     688          0.249         1.000         1.000
AUG     489          0.264         1.900         1.500
SEP     478          0.189         2.200         1.900
OCT     470         '0.474         6.900         6.700
ANN    2956          0.351         6.900         6.700

                    ANNUAL  DIURNAL  TRENDS  (CST)
HR     MEAN            HR    MEAN             HR     MEAN

 0     0.219            8    0.299            16     0.375
 1     0.235            9    0.292            17     0.354
 2     0.159           10    0.328            18     0.398
 3     0.152           11    0.305            19     0.400
 4     0.148           12    0.283            20     0.377
 5     0.223           13    0.250            21     0.345
 6     0.494           14    0.326            22     0.302
 7     0.494           15    0.334            23     0.255
```

```
TEXAS CITY  ALL YEARS    CO   (PPM)

        #OBS          MEAN         MAX          2ND MAX

JAN    515.          0.564        6.000         4.400
FEB    652.          0.478        3.000         2.800
MAR    634.          0.357        5.100         2.800
APR    891.          0.262        4.800         4.700
MAY   1101.          0.300        1.600         1.500
JUN   1086.          0.324        3.400         2.100
JUL   1588.          0.263        1.500         1.200
AUG    898.          0.220        1.900         1.500
SEP    994.          0.183        3.100         2.400
OCT   1265.          0.292        6.900         6.700
NOV   1310.          0.543        7.800         5.600
DEC    960.          0.443        6.000         4.500
ANN  11894.          0.352        7.800         6.900

                    ANNUAL DIURNAL TRENDS (CST)
HR     MEAN          HR    MEAN           HR     MEAN

 0     0.307          8    0.350          16     0.355
 1     0.280          9    0.289          17     0.394
 2     0.245         10    0.282          18     0.468
 3     0.226         11    0.266          19     0.500
 4     0.232         12    0.269          20     0.465
 5     0.261         13    0.261          21     0.447
 6     0.413         14    0.298          22     0.388
 7     0.448         15    0.331          23     0.346
```

SECTION 5

ADDITIONAL METEOROLOGICAL DATA

In addition to the meteorological data monitored at the sites described in Section 4, meteorological observations are made routinely by several governmental organizations. This section provides a description of these additional observations, as well as a summary of typical meteorological conditions for the Houston area.

DESCRIPTION

Seven weather stations in the Houston area regularly report current weather conditions, including cloud cover, visibility, precipitation occurrence, temperature, dew point (no dew point at Freeport), wind direction, and wind speed. Table 5-1 lists information about the location, type of observation, and frequency of observation. Figure 5-1 displays the location of these stations. Other stations reporting surface observations, surrounding Houston, are located at Sabine Pass, Port Arthur, Lufkin, College Station, Victoria, Palacious, and Port O'Connor.

The upper air observations made at Alvin are from radiosonde equipped ballons tracked by theodolite. Temperature, dew point, wind direction, and wind speed are derived from the observation. However, the wind data cannot be obtained if the balloon passes into clouds, and observations are not made on weekends. The nearest regularly reporting upper air stations are located at Victoria, about 110 miles southwest of Houston, and at Lake Charles, about 140 miles east of Houston. These two stations report temperature, dew point, and wind profiles twice daily, at 7 am and 7 pm CDT.

SUMMARY OF METEOROLOGICAL CONDITIONS IN THE HOUSTON AREA

Normals, means, and extremes from National Weather Service data for Houston are provided in Table 5-3, and for Galveston in Table 5-4. Included are temperature, precipitation, humidity, wind, sunshine, and cloud cover information. It should be noted that Houston data from before June 1, 1969 is from the Hobby Airport, while after that date the Houston data is from the Intercontinental Airport. Wind roses for both of these airport locations are shown in Figures 5-2 and 5-3. Each wind rose displays the frequency of occurrence of wind direction and wind speed. The wind direction points toward the center of the wind rose diagram, with the total frequency by direction given to the outside (thus in Figure 5-2 the wind blows from the north 10.21% of the time, from the north-northeast 4.79% of the time, etc.). A scale for the wind speed frequencies is shown in the left lower corner.

TABLE 5-1. HOUSTON AREA WEATHER REPORTING STATIONS

Agency	Location	Station ID	Type Observation	Frequency
NWS	Houston Intercontinental Airport	IAH	Surface hourly	Hourly
NWS	Galveston NWS office (downtown)	(GLS)	Surface synoptic	Every six hours
NWS	NWS Office, Alvin	(HOU)	Upper Air	Weekdays at 7 am CDT
FAA	Houston Hobby Airport	HOU	Surface hourly	Hourly
FAA	Sholes Field, Galveston	GLS	Surface hourly	Hourly
USAF	Ellington Field	EFD	Surface hourly	Hourly
CG	Freeport	8R8	Surface	Every three hours

Abbreviations:

NWS - National Weather Service
FAA - Federal Aviation Adminstration
USAF - U. S. Air Force
CG - U. S. Coast Guard

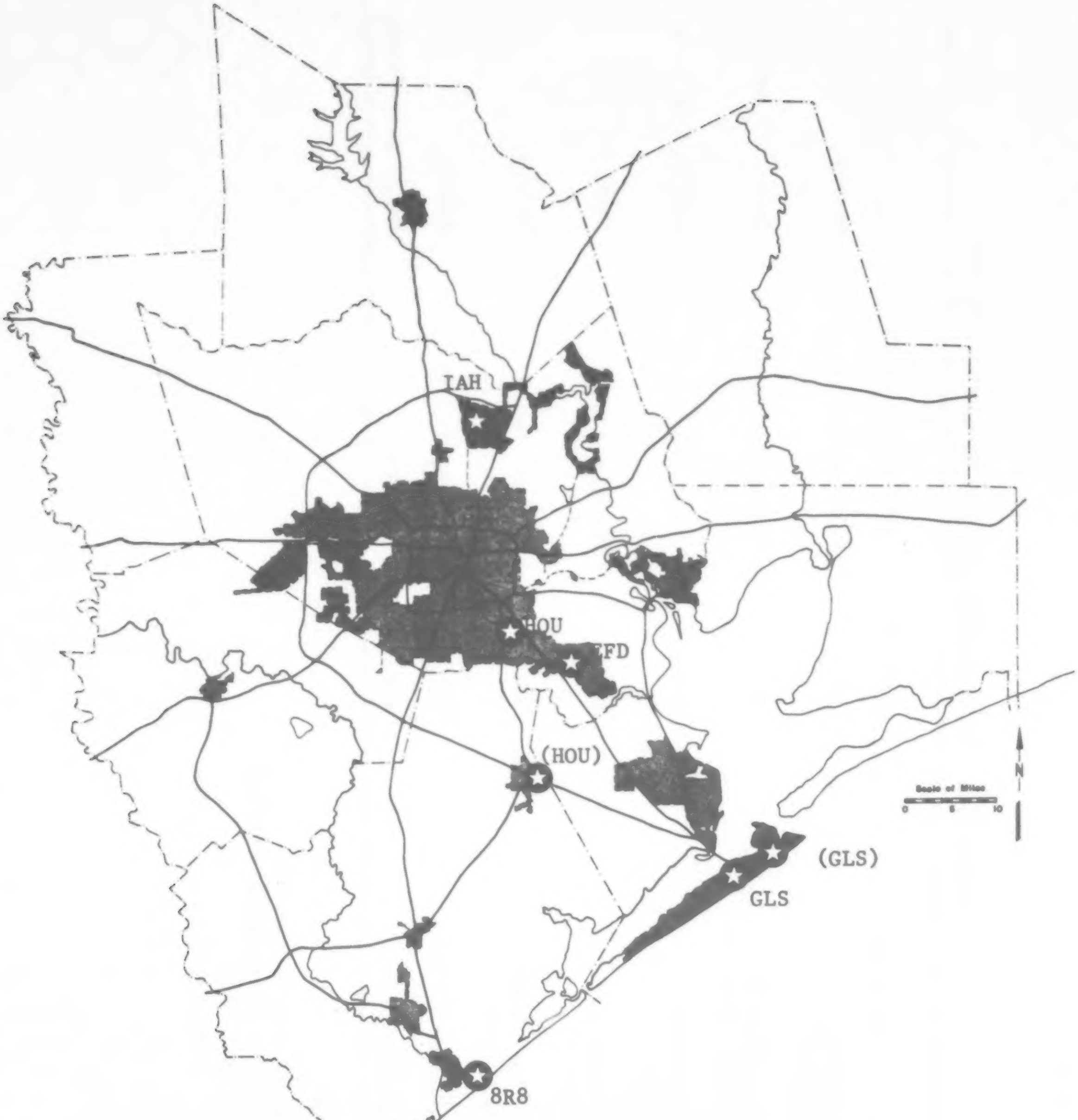
IAH
HOU
EFD
(HOU)
GLS
(GLS)
8R8
Scale of Miles
0
5
10
N

Figure 5-1. Houston area weather reporting stations.

TABLE 5-2. HOUSTON WEATHER SUMMARY - NORMALS, MEANS, AND EXTREMES

	Temperature °F								Relative humidity pct				Wind				Mean number of days						
	Normal			Extremes					(Local Time)								Sunrise to Sunset						
Month	Daily Maximum	Daily Minimum	Monthly	Record highest	Year	Record lowest	Year	Normal Precipitation	Hour 00	Hour 06	Hour 12	Hour 18	Mean speed m.p.h.	Prevailing direction	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ½ mile or less
(a)				8		8			8	8	8	8	8	15	8	8	8	8	8	8	8	8	8
J	62.6	41.5	52.1	84	1975	18	1977	3.57	85	88	64	70	8.1	NNW	45	6.8	8	6	17	11	*	2	7
F	66.0	44.6	55.3	84	1977	22	1973	3.54	84	87	55	57	8.7	SSE	56	5.9	8	7	13	6	*	2	4
M	71.8	49.8	60.8	90	1974	25	1971	1.68	85	88	61	63	9.5	SSE	45	6.9	7	6	18	10	0	4	4
A	79.4	59.3	69.4	89	1973	31	1973	3.54	90	91	60	64	9.2	SSE	52	6.6	7	7	16	7	0	4	4
M	85.9	65.6	75.8	94	1977	45	1976	5.10	90	94	61	64	7.9	SSE	59	6.1	7	11	13	8	0	7	2
J	91.3	70.9	81.1	99	1969	52	1970	4.52	89	92	59	62	7.4	SSE	65	5.7	9	11	10	7	0	8	1
J	93.8	72.8	83.3	101	1969	62	1972	4.12	89	93	58	63	6.4	S	67	6.0	6	15	10	10	0	12	0
A	94.3	72.4	83.4	101	1969	62	1970	4.35	92	94	61	68	5.3	SSE	62	5.9	6	15	10	11	0	13	1
S	90.1	68.2	79.2	97	1971	48	1975	4.65	93	94	65	72	6.5	SSE	60	6.0	7	11	12	10	0	8	2
O	83.5	58.3	70.9	93	1975	33	1976	4.05	92	93	59	74	6.4	ESE	61	5.2	11	9	11	8	0	4	4
N	73.0	49.1	61.1	88	1969	19	1976	4.03	88	90	60	75	7.7	SSE	55	5.4	10	9	11	8	0	3	4
D	65.8	43.4	54.6	83	1974	21	1973	4.04	85	88	62	73	7.7	SSE	65	6.5	9	5	17	9	0	2	6
YR	79.8	58.0	68.9	101	AUG 1969	18	JAN 1977	48.19	88	91	60	67	7.6	SSE	57	6.1	95	112	158	106	*	68	39

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Highest temperature 108 in August 1909; lowest temperature 5 in January 1940 and earlier; fastest mile of wind 84 from NW in March 1926.

(a) Length of record, years, through 1977, based on January data.

NORMALS - Based on record for the 1941-1970 period.
DATE OF EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

TABLE 5-1. GALVESTON WEATHER SUMMARY - NORMALS, MEANS, AND EXTREMES

Month	Temperature °F							Normal Precipitation	Relative Humidity Pct.				Wind				Percent of Possible Sunshine	Mean Number of Days	
	Normal			Extremes						(Local Time)			Mean Speed % m.p.h.	Fastest Mile					
	Daily Maximum	Daily Minimum	Monthly	Record Highest	Year	Record Lowest	Year		Hour 00	Hour 06	Hour 12	Hour 18		Speed m.p.h.	Direction	Year		Precipitation .01 inch or more	Snow, Ice Pellets 1.0 inch or more
(a)				107		107			38	90	60	90	93	106	106		87	106	106
J	59.4	48.3	53.9	77	1969	11	1886	3.02	84	85	77	80	11.6	53	S	1915	48	10	*
F	61.5	50.9	56.2	83	1932	8	1899	2.67	82	84	74	77	11.8	60	N	1927	51	9	*
M	66.0	55.9	61.0	85	1879	27	1943	2.60	84	85	74	79	11.9	50	SE	1952	55	8	0
A	73.3	65.0	69.2	92	1953	38	1938	2.63	85	86	75	80	12.1	57	NW	1961	61	6	0
M	80.0	71.8	75.9	93	1911	52	1954	3.16	82	84	73	77	11.5	66	W	1959	68	6	0
J	85.2	77.4	81.3	99	1918	57	1903	4.05	80	81	70	73	10.7	62	SE	1921	75	6	0
J	87.4	79.0	83.2	101	1932	66	1910	4.41	80	81	70	73	9.8	68	NW	1943	72	9	0
A	87.6	78.9	83.3	100	1924	67	1966	4.40	78	81	69	73	9.4	91	E	1915	70	9	0
S	84.6	75.3	80.0	96	1927	52	1942	5.60	78	81	68	75	10.1	100	NE	1900	68	9	0
O	78.0	68.1	73.1	94	1952	41	1925	2.83	76	80	65	71	10.3	66	SE	1949	72	7	0
N	68.8	58.2	63.5	85	1886	26	1911	3.16	81	84	72	77	11.2	54	N	1950	60	8	0
D	62.7	51.5	57.1	80	1918	18	1880	3.67	82	86	76	80	11.3	50	NW	1954	49	10	0
YR	74.5	65.0	69.8	101	JUL 1932	8	FEB 1899	42.20	81	83	72	76	11.0	# 100	NE	SEP 1900	63	97	*

100 m.p.h. recorded at 6:15 p.m. Sept. 8 just before anemometer blew away. Maximum velocity estimated 120 from NE between 7:30 and 8:30 p.m.

(a) Length of record, years, through 1977, based on January data.

*Less than one half.

NORMALS - Based on record for the 1941-1970 period.

DATE OF AN EXTREME - The most recent in cases of multiple occurrence.

FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

% Through 1964.

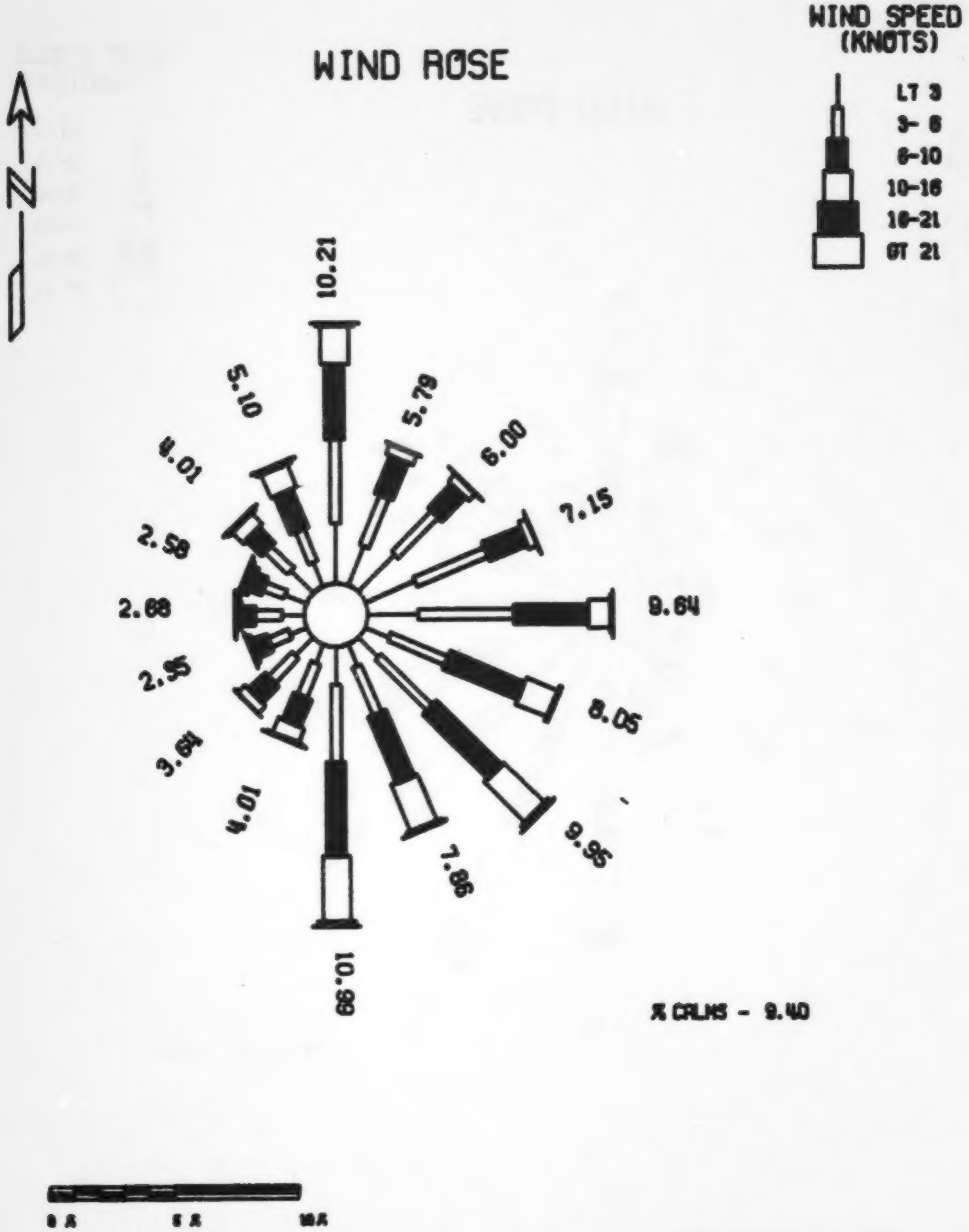

Figure 5-2. Wind Rose for Houston Intercontinental Airport (NWS) for the years 1970-1976.

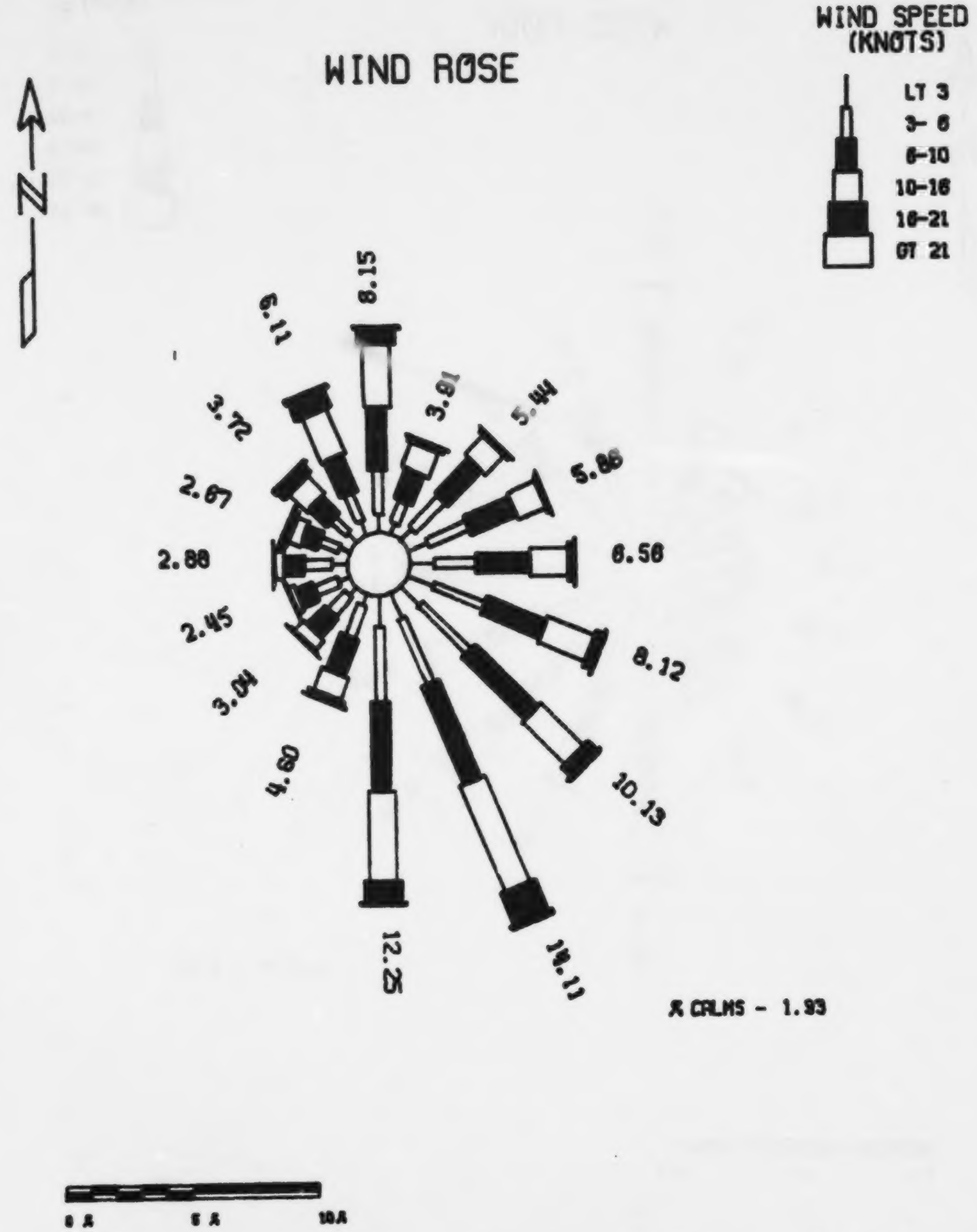

Figure 5-3. Wind Rose for Houston Hobby Airport (NWS) for the years 1959-1969.

SECTION 6

BIBLIOGRAPHY WITH ABSTRACTS

Citations included in the bibliography which follows were identified through an online literature search of various bibliographic data bases, an in-house literature search and through personal contacts. Abstracts were included for citations when available. The majority of these abstracts were provided by the APTIC data base of EPA, the NTIS data base of the U.S. Department of Commerce, and the MGA data base of the American Meteorological Society.

The citations were classified into the following four categories: emissions, monitoring, meteorology and control. Each category is arranged alphabetically by title.

Additions to the bibliography have been provided for inclusion of citations identified since the publication of the draft of this report. The arrangement of these additions is consistent with that of the bibliography, being divided into the categories of emissions, monitoring, meteorology and control. Citations are arranged alphabetically by title within each category.

083035
AIR POLLUTION IMPACT OF MARITIME SHIPPING OPERATIONS IN THE PORT OF HOUSTON.
Cooper, Hal B. H., Jr. and Ghassan M. Mandi
Coastal Zone Manage. J., 1(4):415-432, 1974. 20 refs.
COASTAL ZONE MANAGE J 1974
TECH BIB Method of Support: NONE

The impact of maritime shipping operations on air quality is discussed, with particular reference to the port of Houston. Major air pollutants from maritime shipping operations are sulfur oxides, nitrogen oxides, and particulate matter resulting from the combustion of fuel oil during cruise, berth, and start-up modes. Sulfur oxide emissions are substantial from steamships burning high-sulfur residual fuel oil, and nitrogen oxide emissions are significant during cruise conditions for both steamships and motor ships. Particulate emissions are substantial during start-up and tube cleaning. Offshore terminals for unloading large tankers may result in emissions of 10-20 tons of sulfur oxides daily per ship and 3-5 tons of nitrogen oxides daily per ship during pumping operations. Trace metal constituents present in the oil may catalyze sulfur dioxide and nitrogen dioxide oxidation, resulting in the production of sulfate and nitrate aerosols in the humid Texas Gulf Coast atmosphere. Shipping contributes about 66% of the total sulfur dioxide emissions from transportation sources and almost 3% of the total for Harris County, Texas. (Author abstract modified)

Descriptors: COMBUSTION GASES; COMBUSTION PRODUCTS; POLLUTANTS; AEROSOLS; PARTICULATES; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; HARBORS; BODIES OF WATER; TOPOGRAPHIC LOCATIONS; VESSELS (MARINE); MOBILE EMISSION SOURCES; SOURCES; TRANSPORTATION METHODS; EMISSION FACTORS; CATALYSIS; CHEMICAL AND PHYSICAL PHENOMENA; NITRATES; NITROGEN DIOXIDE (NO_2); NITROGEN OXIDES; OXIDES; SULFUR DIOXIDE; SULFUR OXIDES; SULFATES; SULFUR COMPOUNDS; CHLORIDES; SULFIDES
Identifiers: FERRIC CHLORIDE; LEAD SULFIDE
Category: EMISSION SOURCES

010963
AIR POLLUTION. LIQUID WASTE INCINERATION.
L.W. Coleman, L.F. Cheek
Chem. Eng. Progr., 64(9):84-87, Sept. 1968.
CHEM ENG PROGR HOUSTON TEXAS PLANT OF ROHM AND HAAS CO

1968
TECH Method of Support: FELL GRT
The disposal of nonuniform liquid wastes created a problem at the Houston, Texas plant of Rohm and Haas, Co. The wastes which are residues from various chemical processes and units consist of gummy organics, light hydrocarbons, waxy solids, and heavy, viscous oils. A specially designed incinerator, which was developed to handle this nonuniform material, is described in detail. The basic design appears applicable to a wide range of problems.##
Descriptors: POLLUTANTS; COMBUSTION PRODUCTS; COMBUSTION GASES; SOURCES; FUELS; STATIONARY EMISSION SOURCES; FUEL GASES ; NATURAL GAS; FURNACES; OIL BURNERS; INDUSTRIAL EMISSION SOURCES; INCINERATORS (REFUSE); ELECTRIC, GAS, AND SANITARY SERVICES; REFUSE SYSTEMS; SANITARY SERVICES; STACKS; CONTROL METHODS; PROCESS MODIFICATION; FIRING METHODS; COMBUSTION AIR; DESIGN CRITERIA; TEMPERATURE SENSING INSTRUMENTS; THERMOCOUPLES; MATHEMATICAL ANALYSES; COMBUSTION; CHEMICAL AND PHYSICAL PHENOMENA; PHYSICAL STATES; LIQUIDS; TEMPERATURE; CHEMICAL AND PHYSICAL PROPERTIES; INCINERATORS, LIQUID
Identifiers: LIQUID WASTE INCINERATION
Category: EMISSION SOURCES

046543
AIR POLLUTION REPORT. FEDERAL FACILITIES. METROPOLITAN HOUSTON- GALVESTON INTRASTATE AIR QUALITY CONTROL REGION.
Orr, Franklin M., Jr.
Air Pollution Control Office, Rockville, Md., Federal Facilities Branch, APTD-0998, 29p., July 1971. 7 refs.
1971
TECH Method of Support: INHOUSE
USGRDR No.: NTIS, PB 209704
The status of Federally owned facilities within the Metropolitan Houston-Galveston Air Quality Control Region is presented with regard to the implementation of the objectives of the Clean Air Act, as amended. Fuel (gas, oil, and coal) usage, refuse disposal practices (incineration and open burning) air pollution, and proposed abatement measures are reported for the 87 Federal installations within the Region. The facilities within the Region annually emit a total of 443 tons of nitrogen oxides, 34 tons of particulates, 27 tons of carbon monoxide, 11 tons of hydrocarbons, and 4 tons of sulfur oxides. Federal facilities contribute substantially less than 0.1% of the particulates, CO, and SOx emitted by all stationary sources in the region. Aircraft and other transportation sources are not included in the report, although they are significant.
Descriptors: ABATEMENT; NATIONAL GOVERNMENTS; GOVERNMENTS; ANNUAL; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; URBAN AREAS; METROPOLITAN AREAS; PARTICULATES; POLLUTANTS; FUELS; SOURCES; STATIONARY EMISSION SOURCES; COAL; FUEL GASES; FUEL OILS; INCINERATORS (REFUSE); ELECTRIC, GAS, AND SANITARY SERVICES; INDUSTRIAL EMISSION SOURCES; REFUSE SYSTEMS; SANITARY SERVICES; OPEN BURNING; BURNING; NON-INDUSTRIAL EMISSION SOURCES (STATIONARY); EMISSION INVENTORIES; AIR QUALITY MEASUREMENTS; HYDROCARBONS; CARBON MONOXIDE; OXIDES; NITROGEN OXIDES; SULFUR OXIDES; TEXAS
Identifiers: GALVESTON
Category: EMISSION SOURCES

074278

AMBIENT SAMPLING FOR STATIONARY AMD MOBILE SOURCE HYDROCARBONS IN HOUSTON, TEXAS.

McMurry, J. R., R. E. Flannery, L. H. Fowler, and D. J. Johnson

Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1975. 6 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-45.5.)

AIR POLLUTION CONTROL ASSOC ANNU MEET 68TH BOSTON MASS 1975 1975

FLD Method of Support: NONE

The Texas Air Control Board conducted a study from January through February of 1975 to contrast the industrial and vehicular C2-C5 hydrocarbon fractions at an urban and an industrial site in Houston, Texas. One-hour integrated bag samples were collected and analyzed for C2-C5 hydrocarbons. One site was located in the heavily industrialized ship channel area of Houston, and the other in the downtown area. An automotive hydrocarbon signature, normalized to acetylene, was obtained from samples collected in the Washburn Automotive Tunnel. This sigture, or ratio, was used to derive the vehicular contribution to the total hydrocarbon burden from the acetylene measured at each site. The findings indicate normal diurnal patterns of automotive hydrocarbons at each site. More than 50% of the total C2-C5 hydrocarbon burden at both sites can be attributed to industrial sources. (Author abstract modified)

Descriptors: AIR QUALITY MEASUREMENT PROGRAMS; ADMINISTRATION; PLANS AND PROGRAMS; DIURNAL; INDUSTRIAL AREAS; ENGINE EXHAUSTS; ENGINE EMISSIONS; POLLUTANTS; COMBUSTION PRODUCTS; INDUSTRIAL EMISSION SOURCES; SOURCES; STATIONARY EMISSION SOURCES; AUTOMOBILES; LIGHT-DUTY VEHICLES; MOBILE EMISSION SOURCES; MOTOR VEHICLE SOURCES; TRANSPORTATION METHODS; HYDROCARBONS

Category: EMISSION SOURCES

Radian Corp.,
Area and line source emission inventories for Houston, Texas and vicinity, work plan.
EPA Contract No. 68-02-2608, Task 53.
Austin, TX, Aug. 1978.

21 The objective is to compile area and line source emission inventories of the criteria pollutants for grid-type AQSM's by determining hourly emissions on weekdays and weekends in Harris, Galveston, Brazoria, and Chambers Counties, Texas, in 1975. The inventories in both gridded area and line source format will also be consolidated into a data tape.

076185
AUTOMOBILE EXHAUST EMISSION SURVEILLANCE ANALYSIS OF THE FY73 PROGRAM.
Bernard, Jeffrey, Paul Donovan, and H. T. McAdams
Calspan Corp., Buffalo, N. Y., Office of Air and Waste Management Contract 68-03-0486, Rept. EPA-460/3-75-007, 64p., July 1975. 5 refs.
1975
FLD Method of Support: CONTRACT
USGRDR No.: NTIS, PB 248600/AS

Exhaust emission tests were performed on 1080 in-use 1967 through 1974 model year automobiles and light trucks in six cities: Los Angeles, Denver, Detroit, St. Louis, Houston, and Newark. The mean hydrocarbon, carbon monoxide, and nitrogen oxide levels, averaged for all cities except Denver and Los Angeles, were: 5.78, 72.56, and 4.41 g/mi, respectively. The corresponding figures for Denver were 6.87, 108.54, and 2.84 g/mi, respectively; and those for Los Angeles were 5.44, 65.21, and 3.27 g/mi, respectively. Light duty vehicles showed a general downward trend in hydrocarbons, carbon monoxide, and nitrogen oxide emissions from 1966-1967 model years (pre-control in all cities except Los Angeles) to model year 1973. The influence of the new nitrogen oxides standard was especially noticeable. (Author summary modified)

Descriptors: AREA SURVEYS; ADMINISTRATION; AIR QUALITY MEASUREMENT PROGRAMS; PLANS AND PROGRAMS; ENGINE OPERATING CYCLES; ENGINE EXHAUSTS; ENGINE EMISSIONS; POLLUTANTS; URBAN AREAS; METROPOLITAN AREAS; INSPECTION; CONTROL METHODS; LIGHT-DUTY VEHICLES; MOBILE EMISSION SOURCES; MOTOR VEHICLE SOURCES; SOURCES; TRANSPORTATION METHODS; EMISSION FACTORS; HYDROCARBONS; CARBON MONOXIDE; OXIDES; NITROGEN OXIDES; TRENDS
Category: EMISSION SOURCES

AN - PB-264 381/5SL
TI - Background Information on Hydrocarbon Emissions from Marine Terminal Operations. Volume I. Discussion
TNO - Final rept.
AU - Burklin, C. E.; Colley, J. D.; Owen, M. L.
OS - Radian Corp., Austin, Tex.*Environmental Protection Agency. Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
PD - Nov 76; 225p
IS - U7711
PR - NTIS Prices: PC A10/MF A01
NO - See also Volume 2, PB-264 382.
- EPA/450/3-76/038a
CG - EPA-68-02-1319
CC - 21D; 68A; 85G; 97K
IT - *Hydrocarbons; *Marine terminals; *Assessments; *Air pollution control; Gasoline; Crude oils; Cost estimates; Economics; Emission; Safety; Cargo transportation; Loading procedures; Unloading; Vapor phases; Refrigeration; Absorption; Incinerators; Freight terminals; Chemical composition; Physical properties; Chemical properties; Design criteria; Efficiency; Statistical data; Detectors; Process charting; Chemical analysis

ST - Sources: Houston(Texas); Galveston(Texas); Los Angeles(California); NTISEPAAWM
AB - This report presents results of a study to develop background information necessary for the accurate assessment of hydrocarbon emissions from ship and barge loading and unloading of gasoline and crude oil. The report assesses marine terminal facilities, marine terminal operations, cruise history and product movement statistics, hydrocarbon emission rates and characteristics, control technology state of the art, safety considerations of marine terminal control technology and economics of controlling marine terminal emissions. The report also includes the results of a detailed cost analysis for a refrigeration and an absorption marine terminal vapor recovery system. Data gathering activities focused on the Houston--Galveston area; however, information was also assembled on hydrocarbon emissions from marine terminal operations in the metropolitan Los Angeles area generated by handling of gasoline and crude oils, including Alaskan north slope crude.

AN - PB-264 382/3SL
TI - Background Information on Hydrocarbon Emissions from Marine Terminal Operations. Volume II. Appendices
TNO - Final rept.
AU - Burklin, C. E.; Colley, J. D.; Owen, M. L.
OS - Radian Corp., Austin, Tex.*Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
PD - Nov 76; 209p
IS - U7711
PR - NTIS Prices: PC A10/MF A01
NO - See also Volume 1, PB-264 381.
- EPA/450/3-76/038b
CG - EPA-68-02-1319
CC - 21D; 68A; 85G; 97K
IT - *Hydrocarbons; *Marine terminals; *Assessments; *Air pollution control; Tables(Data); Loading procedures; Unloading; Gasoline; Crude oils; Concentration(Composition); Incinerators; Absorption; Refrigeration; Cargo transportation; Emission; Vapor phases; Statistical data; Chemical analysis; Detection; Graphic methods; Freight terminals; Efficiency; Cost estimates; Economics
ST - Houston(Texas); Galveston(Texas); Los Angeles(California); Sources; *Air pollution sampling; NTISEPAAWM
AB - This volume contains the appendices for volume one. It includes information on vessels transporting crude oil and gasoline in the Houston-Galveston area, vapor control system cost data, results from industry test programs, industry test data; radian emission testing results, radian emission test data and trip reports, and independent analysis of vapor recovery system costs.

104011
Coatings Update Chapter 4. Pollution and the Paint Industry
Brushwell, William
Am. Paint Coatings J. 61(35):60-63, Feb. 7 1977
Doc Type: J; Reviews (Technical)
Air pollution is considered as it affects the paint

industry. In the last few years the industry has made strong efforts t accommodate to the various pollution regulations that have been issued. Points discussed include: the cost of inflation as it relates to the increased concern for pollution free environmental air; the average cost increase due to reformulation to meet requirements as found in specific coatings and paints; future trends relative to emissions regulations; technical and economic information which will aid the Environmental Protection Agency (EPA) in establishing appropriate standards; and the future of hydrocarbon emission regulations in the surface coatings industry. Other topics covered include the figures released by the EPA for varous cities such as Los Angeles; San Francisco; Houston; New York City; Washington, D. C.; Beaumont, Texas; and Phoenix-Tucson regarding their air polluting hydrocarbon emissions. The problem of air pollution relative to the paint industry in England is mentioned. (9 Refs)

Descriptors: Control Agencies; Economics; Costs; Legal Aspects; Regulations; Standards; America; North America; United States; Arizona; California; Los Angeles; San Francisco ; New York State; New York City; Texas; Houston; Washington D C; Europe; Western Europe; United Kindgom; Great Britain; Sources; Stationary Emission Sources; Industrial Emission Sources; Manufacturing Industries; Paints and Allied Production; Surface Coating Operations; Hydrocarbons; Trends

Category: Emission Sources; Emission Sources (Stationary)

043300

DRIVING AND VEHICLE USE PATTERNS IN MAJOR METROPOLITAN CITIES- PHASE I.

Lamoureux, Robert L.

Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 25p., 1972. 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami Beach, Fla., June 18-22, 1972, Paper 72-176.)

AIR POLLUTION CONTROL ASSOC ANNU MEET 65TH MIAMI BEACH FLA 1972

FLD Method of Support: CONTRACT

Approximately 1000 volunteer participants in six U. S. cities (Los Angeles, California; Houston, Texas; Cincinnati, Ohio; Chicago, Illinois; Minneapolis - St. Paul, Minnesota; and New York, New York) had their automobiles instrumented with recording speedometers for one week. The data collected by these instruments, supplemented by data entered into logbooks by the participating drivers, were analyzed to identify significant patterns of driving behavior and automobile use. The results of the survey were used as a basis for subsequent studies directed toward developing the operations data (Phase II) and also to amend the 1972 CBS Federal Test Procedure to provide for cold-hot weighting. The autos surveyed made over 30,000 trips covering over 228,000 miles. On weekdays, the average driver made four and a half trips/day, spent one hour and 19 minutes on the road, and covered about 34 miles. On weekends he drove less, about four trips/day, about an hour on the road, and only 26 miles/day. Time distribution of trips, reasons for trips, and use of freeways were studied.

Descriptors: LOS ANGELES; AMERICA; CALIFORNIA; NORTH AMERICA ; UNITED STATES; CHICAGO; ILLINOIS; MINNESOTA; NEW YORK CITY; NEW YORK STATE; CINCINNATI; OHIO; HOUSTON; TEXAS; URBAN AREAS; METROPOLITAN AREAS; AUTOMOBILES; LIGHT-DUTY VEHICLES; MOBILE EMISSION SOURCES; MOTOR VEHICLE SOURCES; SOURCES; TRANSPORTATION METHODS; MINNESOTA
Identifiers: MINNEAPOLIS-ST. PAUL
Category: EMISSION SOURCES

005591
EMISSIONS FROM WET PROCESS CLINKER COOLER AND FINISH MILL SYSTEMS AT IDEAL CEMENT COMPANY, HOUSTON, TEXAS. (FINAL REPORT).
Riley, Clyde E.
Environmental Protection Agency, Research Triangle Park, N. C., Office of Air Programs, Rept. 71-MM-06, 57p., March 29, 1972. 1 ref.
1972
FLD Method of Support: INHOUSE
An Office of Air Programs source emission test is reported for sampling conducted at the Houston, Texas wet process plant of the Ideal Cement Company. Three particulate runs were performed at each stack for a total of six runs. Clinker cooler emissions (based on the probe, cyclone, and filter catches) ranged from 0.0253 to 0.0448 lbs/ton of feed. Emissions from the finish mill grinder baghouse were between 0.0120 and 0.0201 lb/ton of feed. (Author summary modified)
Descriptors: CEMENTS; CONSTRUCTION MATERIALS; MATERIALS; STACK GASES; POLLUTANTS; WASTE GASES; COMBUSTION GASES; COMBUSTION PRODUCTS; PARTICULATES; MINERAL PROCESSING; INDUSTRIAL EMISSION SOURCES; SOURCES; STATIONARY EMISSION SOURCES; PARTICULATE SAMPLING; SAMPLING METHODS; STACK MONITORING; MEASUREMENT METHODS; MONITORING; SOURCE MONITORING ; BAG FILTERS; CONTROL EQUIPMENT-GAS STREAMS; FABRIC FILTERS; FILTERS; CONTROL EQUIPMENT - GAS STREAMS; COOLING; CHEMICAL AND PHYSICAL PHENOMENA; HEAT TRANSFER; COOLING
Identifiers: CLINKER COOLER
Category: EMISSION SOURCES

040097
HOUSTON-GALVESTON AIR POLLUTION EMISSION INVENTORY.
Mason, David V.
National Air Pollution Control Administration, Durham, N. C., Air Quality and Emission Data Div., Office of Air Programs Pub-APTD-0818, 59p., July 1969. 11 refs.
1969
FLD Method of Support: INHOUSE
USGRDR No.: NTIS, PB 207691
Estimates are provided of total emissions of oxides of sulfur, oxides of nitrogen, hydrocarbons, carbon monoxide, and particulate matter. The emissions of these pollutants are delineated with respect to source type, season of the year, and geographical distribution. Source categories considered were stationary fuel combustion, transportation (vehicles, aircraft, trains, and ships), solid waste disposal, industrial

process losses, and evaporative losses. Facilities that emitted large quantities of air pollutants were considered individually. In 1967 there were 143,000 tons of sulfur oxides emitted, 155,000 tons of particulates, 1,066,400 tons of carbon monoxide, 291,000 tons of hydrocarbons, and 213,000 tons of nitrogen oxides. Industrial processes accounted for 93% of the sulfur oxides, 84% of particulates, and 62% of hydrocarbons. Road vehicles contributed 76% of carbon monoxide. Nitrogen oxides emissions were fairly evenly divided between industrial fuel use, 32%; road vehicles, 21%; industrial processes, 21%; and steam electric sources, 21%.

Descriptors: AREA SURVEYS; ADMINISTRATION; AIR QUALITY MEASUREMENT PROGRAMS; PLANS AND PROGRAMS; SEASONAL; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; URBAN AREAS; METROPOLITAN AREAS; FUEL EVAPORATION; ENGINE EMISSIONS; POLLUTANTS; PARTICULATES; SOURCES; FUELS; STATIONARY EMISSION SOURCES; INDUSTRIAL EMISSION SOURCES; ELECTRIC POWER GENERATION; ELECTRIC, GAS, AND SANITARY SERVICES; STEAM ELECTRIC POWER GENERATION; REFUSE SYSTEMS; SANITARY SERVICES; NON-INDUSTRIAL EMISSION SOURCES (STATIONARY); TRANSPORTATION METHODS; MOBILE EMISSION SOURCES; AIRCRAFT; VESSELS (MARINE); MOTOR VEHICLE SOURCES; RAILROAD VEHICLES; EMISSION INVENTORIES ; AIR QUALITY MEASUREMENTS; HYDROCARBONS; CARBON MONOXIDE; OXIDES; NITROGEN OXIDES; SULFUR OXIDES; TEXAS

Identifiers: GALVESTON

Category: EMISSION SOURCES

AN - PB-279 409/7SL
TI - Houston Urban Plume Study - 1974, Description and Data
TNO - Final rept.
AU - Brock, James R.
OS - Texas Univ. at Austin. Dept. of Chemical Engineering.*Environmental Sciences Research Lab., Research Triangle Park, N.C.
PD - Apr 78; 259p
IS - U7815
PR - NTIS Prices: PC A12/MF A01
- EPA/600/3-78-048b
CG - EPA-R803660
CC - 13B; 68A; 91A
IT - *Air pollution; *Aerosols; *Plumes; Management planning; Atmospheric composition; Sulfur dioxide; Nitrogen oxides; Ozone; Carbon monoxide; Budgets; Texas; Wind(Meteorology); Concentration(Composition); Industrial wastes; Combustion products; Aerial surveys; Particles
ST - *Houston(Texas); NTISEPAORD
AB - The 1974 Houston Urban Plume Study (HUPS) was undertaken as a preliminary investigation of some of the unresolved features of Houston's air pollution problem. HUPS was intended specifically to gain limited information on the spatial and temporal distribution of air pollutants--particularly, primary and secondary aerosols--in the Houston area as an aid should a later intensive investigation of aerosol character and transport be needed. Aerial measurements were made of the principal pollutants (SO2, NOx, O3, CO, aerosol) of the Houston area. Wind-field measurements were also made. These data were used to estimate pollutant budgets. Values for SO2 and NOx (14 metric tons/hr and

40 metric tons/hr. respectively) were reasonably comparable with values derived from emissions inventories of the Texas Air Control Board (13 and 24 metric tons/hr. respectively). On the basis of the limited sampling period, the industrial area (east of dowrtown Houston) apparently is the major contributor of primary air pollutants in the Houston area. In the morning hours above the mixed layer, relatively large ozone concentrations (max. 0.2 ppm)--almost certainly of photochemical--origin were found that correlated closely with light scattering aerosol, thus indicating the existence above the mixed layer of strong secondary aerosol sources.

082771
IDLE FUEL CONSUMPTION IN PASSENGER CARS.
Environmental Protection Agency, Ann Arbor, Mich., Technology Assessment and Evaluation Branch (Editors)
Preprint, 9p., July 1975.
1975
LAB Method of Support: INHOUSE

Passenger cars (1972-1974 model years) using conventional gasoline engines and representative of in-use vehicles were selected from the areas of Denver, Detroit, and Houston for measurements of idle mass emissions and fuel consumption. The average idle mass emissions of hydrocarbons, carbon monoxide, and nitrogen oxides were 0.90, 16.4, and 0.25 g/min, respectively. Fuel consumption at idle averaged 0.82 gal/hr. Diesel and stratified charge vehicles showed significantly lower idle fuel consumption than did conventional vehicles.

Descriptors: ENGINE OPERATING CYCLES; ENGINE EXHAUSTS; ENGINE EMISSIONS; POLLUTANTS; INSPECTION; CONTROL METHODS; DIESEL ENGINES; ENGINES; INTERNAL COMBUSTION ENGINES; POWER SOURCES; SOURCES; SPARK IGNITION ENGINES; STRATIFIED CHARGE ENGINES; HYDROCARBONS; CARBON MONOXIDE; OXIDES; NITROGEN OXIDES; ENGINE OPERATING CYCLES
Identifiers: IDLE MODE
Category: EMISSION SOURCES

004876
THE NEED FOR A POLLUTION-FREE VEHICLE.
A. H. Sweet, B. J. Steigerwald, and J. H. Ludwig
J. Air Pollution Control Assoc., 18 (2):111-113, Feb. 1968. 13 refs. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967, Paper 67-8.)
J AIR POLLUTION CONTROL ASSOC 1968
THEO Method of Support: FELL GRT

The immediacy of the need for pollution-free vehicles is investigated by projecting to 2010 vehicle emission densities for eight urban areas and measures of population exposure to pollution for four cities. Three degrees of emission control are applied. Application of 50% control to 1968 automobiles maintains emission densities below present levels for the next 20 years, but is less effective in reducing population exposure to pollution, in some cases only slowing the rate of growth. Application of 50% control in 1968 and 80% in 1973 fails to reduce emission densities below 50% of the present. Air quality criteria may demand more significant reduction, perhaps attainable only by the substitution of pollution-free vehicles. (Authors' abstract)##

Descriptors: CALIFORNIA; AMERICA; NORTH AMERICA; UNITED STATES; LOS ANGELES; COLORADO; CONNECTICUT; GEORGIA; ATLANTA; ILLINOIS; CHICAGO; MARYLAND; NEW YORK STATE; NEW YORK CITY; TEXAS; HOUSTON; URBAN AREAS; METROPOLITAN AREAS; POLLUTANTS; ENGINE EMISSIONS; SOURCES; TRANSPORTATION METHODS; MOBILE EMISSION SOURCES; POWER SOURCES; INTERNAL COMBUSTION ENGINES; ENGINES; MOTOR VEHICLE SOURCES; CONTROL METHODS; AUTOMOTIVE EMISSION CONTROL; CARBON MONOXIDE; OXIDES

Identifiers: BALTIMORE (MARYLAND); DENVER, COLORADO; HARTFORD, CONN.

Category: EMISSION SOURCES

Littman, Fred E., Robert W. Griscom, and Otto Klein,
Regional Air Pollution Study (RAPS), point source emission inventory, final report.

Creve Coeur, MO, Rockwell International, Atomics International Division, Air Monitoring Center, July 1976.

Air pollution-emission inventories; *Air pollution-emission factors; Sampling and sample handling; Air pollution-sources-stationary; Hydrocarbo air pollution; SO_2-air pollution; NO_x-air pollution; CO-air pollution; Air pollution-particulate emissions-measurement; Air quality-data handling;

Emissions data from stationary point sources in the St. Louis Interstate AQCR have been gathered during the calendar year of 1975. Data for "criteria" pollutants - SO_2, NO_x, Particulates, CO and Hydrocarbons - will be available on an hourly basis. Emissions from large sources are based on hourly, measured values of pertinent operating parameters. Those from smaller sources, between 10 and 1000 tons per year of SO_2, for example, are based on annual data modified by a detailed operating pattern.

015388

REPORT FOR CONSULTATION ON THE METROPOLITAN HOUSTON-GALVESTON INTRASTATE AIR QUALITY CONTROL REGION (TEXAS).

Texas Air Control Board, Austin (Editors)

Washington, National Air Pollution Control Administration, 1969, 27p. 5 refs.

1969

FLD Method of Support: NONE

A proposal is presented in accordance with the Air Quality Act of 1967 to abate air pollution in the metropolitan Houston-Galveston area comprising the following counties: Harris, Galveston, Brazoria, Fort Bend, Waller, Montgomery, Chambers, and Liberty. Regional boundary designations include evaluations of topography, meteorology, emission inventory, air quality analysis, suspended particulate air levels, sulfur oxide levels, and carbon monoxide levels. Urban factors with respect to population and industry are also taken into consideration. The major sources of emission were recorded as transportation, combustion fiels, refuse disposal, and industrial processes, and were located in Harris, Galveston, Brazoria, and Fort Bend counties. The proposed area satisfies the following criteria for determining area size: A region should be self-contained with respect to air pollution sources and receptors; boundaries should be designed to meet not only present but also future conditions; and boundaries should be compatible with and even foster unified and cooperative governmental administration of the air resources throughout the region.

Descriptors: TEXAS; AMERICA; NORTH AMERICA; UNITED STATES; URBAN AREAS; METROPOLITAN AREAS; PARTICULATES; POLLUTANTS; FUELS; SOURCES; STATIONARY EMISSION SOURCES; INDUSTRIAL EMISSION SOURCES; SEWERAGE SYSTEMS; ELECTRIC, GAS, AND SANITARY SERVICES; SANITARY SERVICES; NON-INDUSTRIAL EMISSION SOURCES (STATIONARY); TRANSPORTATION METHODS; MOBILE EMISSION SOURCES; AIR QUALITY MEASUREMENTS; EMISSION INVENTORIES; METEOROLOGY; ATMOSPHERIC PHENOMENA; CARBON MONOXIDE; OXIDES; SULFUR OXIDES; ABATEMENT; AREA SURVEYS; ADMINISTRATION; AIR QUALITY MEASUREMENT PROGRAMS; PLANS AND PROGRAMS; PROPOSALS; AIR RESOURCE MANAGEMENT; GOVERNMENTS; CLEAN AIR ACT; LEGAL ASPECTS; LEGISLATION; PLANNING AND ZONING; AREA EMISSION ALLOCATIONS

Category: LEGAL AND ADMIN; EMISSION SOURCES; CONTROL METHODS

041838
SMOG SCRAMBLE SPANS NATION.
Chem. Eng. News, 32(12):1108-1113, March 22, 1954.
CHEM ENG NEWS 1954
TECH Method of Support: NONE

Contaminants, their sources, climatic conditions, surrounding terrain--all make control an enigma peculiar to each area. Many eastern cities have good records in reducing air pollution, such as Pittsburgh, Cleveland, and Cincinnati. Pollution sources are indicated for New York City, San Francisco, Chicago, Houston, Los Angeles, and several parts of the South. Official agencies responsible for air pollution in these areas are mentioned as well as their abatement programs. Air pollution in Oregon and Washington State is also considered. Health effects of air pollution are cited, and the London fog of 1952 is discussed. The participation of professional chemical organizations in air pollution abatement is mentioned.

Descriptors: ABATEMENT; CHEMISTS; PERSONNEL; TECHNICAL SOCIETIES; HEALTH IMPAIRMENT; DISEASES AND DISORDERS; LOS ANGELES; AMERICA; CALIFORNIA; NORTH AMERICA; UNITED STATES; SAN FRANCISCO; LONDON; EUROPE; GREAT BRITAIN; UNITED KINGDOM; WESTERN EUROPE; CHICAGO; ILLINOIS; NEW YORK CITY; NEW YORK STATE; OREGON; HOUSTON; TEXAS; WASHINGTON (STATE); URBAN AREAS ; METROPOLITAN AREAS; SMOG; PARTICULATES; POLLUTANTS; SUSPENDED PARTICULATES; FOG; ATMOSPHERIC PHENOMENA; CONDENSATION (ATMOSPHERIC); METEOROLOGY

Category: GENERAL

062669
A STUDY OF EMISSIONS FROM LIGHT DUTY VEHICLES IN DENVER, HOUSTON AND CHICAGO. FISCAL YEAR 1972.
Liljedahl, Douglas R.
Automotive Testing Labs., Inc., Aurora, Colo., Environmental Protection Agency Contract 68-01-0455, Rept. APTD-1504, 182p., July 1973.
1973
LAB FLD Method of Support: CONTRACT
USGRDR No.: NTIS, PB 232115/AS

Results are presented from a laboratory study of emissions from light duty vehicles (1966-1972 model years) operating in Denver, Houston, and Chicago. Exhaust emission tests for hydrocarbons, carbon monoxide, carbon dioxide, and nitrogen oxides were conducted according to the 1975 Federal Test Procedures on vehicles as received, while evaporative emission tests were conducted using a modified version of the Society of Automotive Engineers, SAE J171 SHED procedure. Topics covered in the report include: program objectives; program design; test vehicle procurement; facilities and equipment; equipment qualification, calibration, and cross-check; test procedures; data handling; and test results. Hydrocarbon and CO emissions tended to decrease in the more current model years, while CO2 and NOx emissions tended to increase. Exhaust hydrocarbon and CO emissions were significantly higher in Denver, a high altitude city, than in the other two cities; while NOx emissions were significantly lower in Denver. (Author abstract modified)

Descriptors: COLORADO; AMERICA; NORTH AMERICA; UNITED STATES ; CHICAGO; ILLINOIS; HOUSTON; TEXAS; ENGINE EXHAUSTS; ENGINE EMISSIONS; POLLUTANTS; FUEL EVAPORATION; MOTOR VEHICLE SOURCES ;- MOBILE EMISSION SOURCES; SOURCES; TRANSPORTATION METHODS; EMISSION INVENTORIES; TESTING FACILITIES; HYDROCARBONS; CARBON DIOXIDE; OXIDES; CARBON MONOXIDE; NITROGEN OXIDES
Category: EMISSION SOURCES

-25-
AN - Pb-220 142/4
TI - A study of Emissions from Light Duty Vehicles in Six Cities.
OS - Automotive Environmental Systems, Inc., Westminster, Calif.
PD - Mar 73: 311p
IS - U7313
PR - pc $6.00/Mf $0.95
- Aptd-1497
CG - Epa-68-04-0042
CC - 13B; 68A
IT - (*air pollution, Exhaust gases); (*exhaust gases, *motor vehicles); Hydrocarbons; Carbon monoxide; Carbon dioxide; Nitrogen oxides; Evaporation; Tests; Statistical analysis; Surveys. Concentration(composition), Tables(data)
ST - Los Angeles(california); chicago(illinois); houston(texas); denver(colorado); saint Louis(missouri); washington(district of Columbia); automobile exhaust; Oap
AB - A comprehensive study of emissions from light duty vehicles was performed in six cities of the United States to determine the contribution to atmospheric pollution by the vehicle population. Over 1.000 vehicles of the 1957 through 1971 model years were tested to determine the levels of hydrocarbon. carbon monoxide,

carbon dioxide and oxides of nitrogen exhaust emissions. Evaporative emission tests using the Shed technique were performed on a subsample of vehicles in Los Angeles and Denver. Comprehensive statistical analyses of emission results by city, manufacturer, make, model year and engine class are presented.

076088

A STUDY OF EMISSIONS FROM 1967-1974 LIGHT-DUTY VEHICLES IN DENVER, HOUSTON, AND DETROIT.

Liljedahl, D. R. and J. L. Terry

Automotive Testing Labs., Inc., Aurora, Colo., Office of Air and Waste Management Contract 68-03-0388, Rept. EPA-460/3-74-015, 438p., Oct. 1974.

1974

FLD Method of Support: CONTRACT

USGRDR No.: NTIS, PB 245836/AS

Exhaust emission tests were performed on 540 vehicles (1967-1974 model year) operating in Denver, Houston, and Detroit. Each vehicle was examined in an as-received condition using the 1975 Federal Test Procedure. Evaporative emission tests were also performed on 20 1973 model-year vehicles in the Denver area. A variety of additional exhaust emission tests under different vehicle operating conditions were also performed. Model emissions data were developed from 75 of the 1972, 1973, and 1974 model-year vehicles in each state using the Surveillance Driving Sequence and steady state testing procedures. Mean hydrocarbon, carbon monoxide, and nitrogen oxide emissions from vehicles in the Denver area were: 6.17, 99.0, and 2.87 g/mi, respectively. Vehicles in the Houston area showed mean values of 5.20, 70.7, and 5.39 g/mi, respectively; while vehicles in the Detroit area showed mean levels of 5.85, 66.8, and 5.31 g/mi, respectively.

Descriptors: AREA SURVEYS; ADMINISTRATION; AIR QUALITY MEASUREMENT PROGRAMS; PLANS AND PROGRAMS; ENGINE OPERATING CYCLES; ENGINE EXHAUSTS; ENGINE EMISSIONS; POLLUTANTS; FUEL EVAPORATION; COLORADO; AMERICA; NORTH AMERICA; UNITED STATES; DETROIT; MICHIGAN; HOUSTON; TEXAS; METROPOLITAN AREAS; INSPECTION; CONTROL METHODS; MOTOR VEHICLE SOURCES; MOBILE EMISSION SOURCES; SOURCES; TRANSPORTATION METHODS; SOURCE MONITORING; MEASUREMENT METHODS; MONITORING; HYDROCARBONS; CARBON MONOXIDE; OXIDES; NITROGEN OXIDES; COLORADO; ENGINE OPERATING CYCLES

Identifiers: DENVER; STEADY-STATE TEST; SURVEILLANCE DRIVING SEQUENCE; 1975 FEDERAL TEST PROCEDURE

Category: EMISSION SOURCES

AN - PB-274 560/2SL
TI - Study of Exhaust Emissions from 1965 through 1975 Model Year Light-Duty Vehicles in Houston, Chicago, and Phoenix
AU - Liljedahl, Douglas R.; Terry, Jerry L.
OS - Automotive Testing Labs., Inc., Aurora, Colo.*Environmental Protection Agency, Ann Arbor, Mich. Emission Control Technology Div.
PD - Apr 76; 639p
IS - U7804

PR - NTIS Prices: PC A99/MF A01
- EPA/460/3-76/001
CG - EPA-68-03-2183
CC - 13B; 68A
IT - *Exhaust emissions; *Air pollution; Sources; Texas; Arizona; Illinois; Standards; Sampling; Concentration(Composition); Tables(Data); Metropolitan areas
ST - *Light duty vehicles; Phoenix(Arizona); Chicago(Illinois); Houston(Texas); *Air pollution sampling; Emission factors; NTISEPAMAP
AB - Emission tests were performed on a sample of light-duty vehicles operating in the Chicago, Houston and Phoenix metropolitan areas. All vehicles were tested in the as-received condition by the current Federal Test Procedure. The majority of vehicles were tested in connection with the development of emission factors. Many of these were also tested using the Surveillance Driving Sequence and Steady State Procedures for emission factors development. Fifteen vehicles were additionally tested using these modal procedures to establish emission factors for loaded vehicles and vehicles towing trailers.

AN - PB-280 725/3SL
TI - Study of Exhaust Emissions from 1966 through 1976 Model-Year Light-Duty Vehicles in Denver, Chicago, Houston and Phoenix
AU - Liljedahl, Douglas R.; Terry, Jerry L.
OS - Automotive Testing Labs., Inc., Aurora, Colo.*Environmental Protection Agency, Ann Arbor, Mich. Emission Control Technology Div.
PD - Aug 77; 803p
IS - U7817
PR - NTIS Prices: PC A99/MF A01
- EPA/460/3-77/005
CG - EPA-68-03-2378
CC - 13B; 68A
IT - *Air pollution; *Exhaust emissions; Motor vehicles; Tests; Sulfates; Fuel consumption; Evaporation; Data analysis; Tables(Data); Hydrocarbons; Carbon monoxide; Carbon dioxide; Nitrogen oxides
ST - *Light duty vehicles; *Emission factors; Procedures; Fugitive emissions; NTISEPAMAP
AB - Emission tests were performed on a sample of light-duty vehicles operating in the Chicago, Houston, Phoenix and Denver metropolitan areas. These tests were performed for the determination of light-duty vehicle emission factors. All vehicles were tested in the as-received condition by the Federal Test Procedure. Other tests included the Highway Fuel Economy Test, Modal Emission Tests, the Federal Short Cycle Test, a composite of the New Jersey ACID Test and the New York Short Test, the Clayton Keymode Test, the Two Speed Idle Test and the Federal Three Mode Test. A Revised Federal Three Mode Test and the Sulfate Emission Test were also performed. The Phoenix sample included twenty diesel-powered vehicles which were tested by the diesel version of the Federal Test Procedure, the Highway Fuel Economy Test and Modal Emission Tests. Evaporative Emission Tests by the SHED procedure were also conducted on twenty vehicles in Denver. (Portions of this document are not fully legible)

ID NO.- MJA28080124
Urban and industrial air pollution in Houston, Texas, Pt. 1, Hydrocarbons.
Siddiqi, Aziz
Air Quality Management Program, Dept. of Chem. Engr., Univ. ofHouston, TX.
Atmospheric Environment. Oxford, 11(2): 131-143, Feb. 1977. Refs. DAS, DLC (TD881.A8)
CTRY OF PUBL:UK

During the summer of 1973 and 1974, ambient air samples were collected at sites in downtown Houston and the nearby Pasadena and La Porte industrial complex to determine the hydrocarbon composition in relation to emission sources. Ground level samples were collected at one-hour intervals and analyzed for C.SUB 1.-C.SUB 6. hydrocarbons without delay to avoid any sample deterioration resulting from storage. In addition, at selected times, helicopters were used to sample at 500- and 1000-ft elevation. Meteorological conditions were recorded, and their effects on the hydrocarbon composition were evaluated. As expected, the hydrocarbon spectrum of downtown Houston air resembled that of auto exhaust and showed a strong dependence upon traffic density and local meteorology. The hydrocarbon composition at the industrial sites largely depended upon the wind direction and magnitude, i.e., local point sources. This study has also indicated removal of some of the hydrocarbons by the photochemical reactions.

DESCRIPTORS: Hydrocarbons in air; Urban atmospheric pollution; Industrial atmospheric pollution; Houston, Texas

047602
VEHICLE OPERATIONS SURVEY. VOLUME II. (FINAL REPORT).
Scott Research Labs., Inc., San Bernardino, Calif. (Editors)
Coordinating Research Council, Inc. and Office of Air Programs Proj. CAPE-10-68 (1-70), SRL 2922-13-1271, APTD-1298, 148p., Dec. 17, 1971.
1971
THEO LAB Method of Support: CONTRACT
USGRDR No.: NTIS, PB 210844

Automobile driving patterns were defined, determined, and typified in terms of operating modes. Data were collected in five major metropolitan areas and subsequently combined to form an overall composite of urban driving patterns. Traffic survey routes were also constructed for Los Angeles, Houston, Cincinnati, Chicago, and New York City. The data were processed to identify and summarize the basic vehicle operating modes: acceleration, deceleration, cruise, and idle.

Mode characteristics such as frequency of occurrence, total duration, average duration, and transition probability were defined in matrix form. Supplementary information was obtained on average trip speed, acceleration-deceleration profiles, and manifold vacuum rates at various cruise conditions. Pattern similarities between cities and variability within a city were also defined. A road route representing the overall five-city composite was constructed in Detroit. Detailed information on instrumentation, survey route design, data processing, and program results is presented. (Author summary modified)

Descriptors: LOS ANGELES; AMERICA; CALIFORNIA; NORTH AMERICA ; UNITED STATES; CHICAGO; ILLINOIS; DETROIT; MICHIGAN; NEW YORK CITY; NEW YORK STATE; CINCINNATI; OHIO; HOUSTON; TEXAS; URBAN AREAS; METROPOLITAN AREAS; ENGINE OPERATING CYCLES; SOURCES; OPERATING VARIABLES; AUTOMOBILES; LIGHT-DUTY VEHICLES ; MOBILE EMISSION SOURCES; MOTOR VEHICLE SOURCES; TRANSPORTATION METHODS; DATA ANALYSIS; DATA HANDLING SYSTEMS; INSTRUMENTATION; MAPPING; RESEARCH METHODOLOGIES

Category: EMISSION SOURCES

047601

VEHICLE OPERATIONS SURVEY. VOLUME I. (FINAL REPORT).

Scott Research Labs., Inc., San Bernadino, Calif. (Editors)

Coordinating Research Council, Inc. and Office of Air Programs CRC-APRAC Proj. CAPE-10-68 (1-70), SRL 2922-13-1271, APTD-1297, 148p., Dec. 17, 1971. 10 refs.

1971

THEO FLD Method of Support: CONTRACT

USGRDR No.: NTIS, PB 210640

Automobile driving patterns are defined, determined, and typified in terms of operating modes. Data were collected in five major metropolitan areas and subsequently combined to form an overall composite of urban driving patterns. Traffic survey routes were also constructed for Los Angeles, Houston, Cincinnati, Chicago, and New York City. The data were processed to identify and summarize the basic vehicle operating modes: acceleration, deceleration, cruise, and idle. Mode characteristics such as frequency of occurrence, total duration, average duration, and transition probability were defined in matrix form. Supplementary information was obtained on average trip speed, acceleration-deceleration profiles, and manifold vacuum rates at various cruise conditions. Pattern similarities between cities and variability within a city were also defined. A road route representing the overall five-city composite was constructed in Detroit. Program objectives, procedures, and analysis of results are presented. (Author summary modified)

Descriptors: LOS ANGELES; AMERICA; CALIFORNIA; NORTH AMERICA ; UNITED STATES; CHICAGO; ILLINOIS; DETROIT; MICHIGAN; NEW YORK CITY; NEW YORK STATE; CINCINNATI; OHIO; HOUSTON; TEXAS; URBAN AREAS; METROPOLITAN AREAS; ENGINE OPERATING CYCLES; SOURCES; OPERATING VARIABLES; AUTOMOBILES; LIGHT-DUTY VEHICLES ; MOBILE EMISSION SOURCES; MOTOR VEHICLE SOURCES; TRANSPORTATION METHODS; MAPPING; DATA ANALYSIS; DATA HANDLING SYSTEMS; RESEARCH METHODOLOGIES

Category: EMISSION SOURCES

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MONITORING

Texas Air Control Board, Data Listing,
Aldehydes in Houston's Air 1973-1976.
Austin, TX, Jan. 1977.

***Aldehydes-air pollution; Texas-air pollution;
Houston, TX-air pollution;**

Radian Corp.,
Air quality monitoring resources identification and evaluation Northeast corridor and Texas Gulf Coast Regions, final report, 2 vols.
DCN 78-100-153-03, API Contract.
Austin, TX, Jan. 1978.

***Air pollution-monitoring; Air quality-data; Monitoring-instrumentation;
Sampling and sample handling;**

Radian Corp.,
Aldehydes monitoring, draft report.
DCN 78-100-169-01, HOAS Contract.
Austin, TX, Jan. 1978.

*Aldehydes-monitoring; Aldehydes-sampling; Formaldehyde-monitoring;
Gas chromatography-applications; Houston, TX-air pollution; Haze; Sampling
and sample handling;

One-hour samples were collected for total aldehydes and formaldehyde analysis at two sites in Houston from 5 a.m. to 5 p.m. (CDT) during the period from August 3 to October 13, 1977. Additionally, four 3-hour samples were taken for a ten day period at each site and analyzed for C_1-C_6 aldehydes on a gas chromatograph.

A considerable number of the one-hour samples were below the minimum detectable limit of the total aldehydes and formaldehyde analytical procedures. For the detailed sampling for C_1-C_6 aldehydes, all samples were below the minimum detectable.

Texas Air Control Board, Technical Support Program, Air Quality Evaluation Division,
Ambient air quality survey Kountze, Beaumont, Port Arthur, and McFaddin Beach, Texas.
Austin, TX, April 1974.

Air pollution-monitoring; Monitoring; *Texas-air pollution; Air pollution-meteorological factors; Air pollution-particulate emissions-meteorological factors; Air pollution-particulate emissions-monitoring; CO-monitoring; Methane-monitoring; Hydrocarbons-monitoring; SO_2-monitoring; NO_2-

monitoring; Ozone-monitoring; Photochemical pollutants-monitoring; Wind direction;

An ambient air quality survey was conducted from April 12 through October 2, 1973, in the Southeast Texas Air Quality Control Region. The mobile monitoring station used to conduct the study was equipped to monitor continuously levels of ozone, nitrogen dioxide, sulfur dioxide, total hydrocarbons, methane, and carbon monoxide. Twenty-four-hour suspended particulate samples collected at the station throughout the study were analyzed for 31 elements. Recording of wind speed and direction allowed analysis of pollution levels to be performed as a function of wind direction.

070471
ANALYSIS OF VOLATILE ORGANIC COMPOUNDS.
Zlatkis, Albert
Houston Univ., Tex., National Aeronautics and Space Administration Contract NAS9- 8260, NASA Case MSC-14428-1, 44p., 1974 (?). 1 ref.
1974
LAB FLD Method of Support: NONE
USGRDR No.: NTIS, N74-19776

A system for gas chromatographic analysis of a wide range of volatile organic compounds in air and water smaples, biological samples, body fluids and petroleum samples is described which permits greater speed, reproducibility, and composition discrimination than prior art devices. A porous polymer of 2,6-diphenyl-p-phenylene oxide is used as the adsorbent. The system includes a sample trap for capturing and enriching the organic volatiles, an injector port for directly injecting the entrapped organic volatiles into a cryogenic precolumn, and a capillary separating column. The solid adsorbent used in the sample trap has the following properties: high affinity for volatile organic compounds, hydrophobicity, temperature stability up to 400 C, good desorption capability, and relative inertness to the sample. The injector port is formed of a hollow body having inlet and outlet ports. The sample trap is inserted into the body of the injector port and maintained in sealed engagement with the outlet port. The injector port is placed onto an injector heater of a gas chromatograph to effect desorption of the entrapped volatiles. Helium gas is introduced at the inlet port to carry the volatiles directly into the cryogenic precolumn. The gas chromatographic capillary separating column is formed of etched nickel which facilitates the separation of a large number of specific organic compounds from a very small amount of organic volatiles. Approximately 100 substances, almost exclusively hydrocarbons, were identified with the system suing air samples from various locations in the Houston area.

Descriptors: BODY FLUIDS; BIOLOGICAL CONSTITUENTS AND PARTS; FUEL OILS; FUELS; SOURCES; STATIONARY EMISSION SOURCES; GAS CHROMATOGRAPHY; ANALYTICAL METHODS; CHROMATOGRAPHY; TRAPPING (SAMPLING); GAS SAMPLING; SAMPLING METHODS; DESIGN CRITERIA; HYDROCARBONS; VAPORS; CHEMICAL AND PHYSICAL PHENOMENA; PHYSICAL STATES

Category: MEASUREMENT METH

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MONITORING

AN - PB-264 590/1SL
TI - Analytical and Experimental Assessment of Highway Impact on Air Quality
TNO - Research rept.
AU - Bullin, J. A.; Polasek, J. C.
OS - Texas Transportation Inst., College Station.**Texas Transportation Inst. College Station.*Federal Highway Administration, Austin, Tex. Texas Div.
PD - 18 Aug 76; 127p
IS - U7711
PR - NTIS Prices: PC A07/MF A01
NO - Prepared in cooperation with Texas State Dept. of Highways and Public Transportation, Austin. Transportation Planning Div.
- FHWA-TX-75-218
RN - TTI-2-8-75-218; RR-218-1
CC - 13B; 9B; 68A
IT - *Air pollution; *Freeways; *Data acquisition; Highways; Texas; Carbon monoxide; Models; Measurement; Sampling; Computer programming; Dispersing; Concentration(Composition); Experimental data; Meteorological data; Environmental impacts; Data processing; Computer programs
ST - *Houston(Texas); Air quality maintenance; NTISDOTFHA
AB - Air quality measurements along Houston freeways have been made at an 'at-grade' site and are to be started shortly at a 'cut' site. These measurements are used to characterize carbon monoxide concentrations downwind from highway line sources. Measurements at each site consist of carbon monoxide concentrations at 10 locations, vehicle length, speed and count by lane, and detailed meteorological data from four stations between five and 101.5 feet. All of the instruments are interfaced to a Data General Nova 1200 computer which allows the data to be taken simultaneously and on a rapid time basis. The data from the experimental program will be used to verify line source dispersion models for Texas. Experimental data from essentially all previous experimental programs have been assembled and used in developing and verifying an improved roadway dispersion model.

Texas Air Control Board,
Annual data summary Air Quality Control Regions 5, 7, and 10 for 1973, 1974 and 1975. Austin, TX.

065248
ATMOSPHERIC AEROSOL MEASUREMENTS FROM AIR OR SPACE PLATFORMS.
Severs, Richard K.
Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 20p., 1974. 17 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-115.)
AIR POLLUTION CONTROL ASSOC ANNU MEET 67TH DENVER COLO 1974 1974
FLD Method of Support: NONE
The feasibility of measuring atmospheric aerosol characteristics from air or space platforms utilizing remote sensors and ground based secondary reflectance targets was

investigated. Secondary reflectance targets (bulk storage tanks) were located in the industrial area of Houston and near Galveston Bay. These areas experienced high and low ambient air aerosol mass loadings. Film/filter channels were used to define frequency bandwidths. Multi-channel remote sensor data were obtained by microdensitometry and used to calculate the aerosol extinction coefficient. These were 3.583 and 3.853 respectively. Houston and Texas air sampling network high volume suspended particulate data were used to generate computer isopleth maps of suspended particulates over the test site areas. On-site 5 hr high-volume measurements were also conducted to establish the mass loading of the atmosphere, 70 micrograms/cu m in the industrial section. In addition, a 5-channel nephelometer was used to collect data at the site. After demonstrating that the data best fit the Junge aerosol distribution, linear regression analyses were used to calculcte the scattering coefficients, which were 1.997 and 1.422 respectively. (Author abstract modified)

Descriptors: SURVEY METHODS; ADMINISTRATION; AIR QUALITY MEASUREMENT PROGRAMS; PLANS AND PROGRAMS; FEASIBILITY STUDIES; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; INDUSTRIAL AREAS; AEROSOLS; PARTICULATES; POLLUTANTS; SUSPENDED PARTICULATES; MISSILE AND SPACECRAFT LAUNCH VEHICLES ; MOBILE EMISSION SOURCES; SOURCES; AIR QUALITY MEASUREMENTS; MONITORING; MEASUREMENT METHODS; COMPUTERS; MAPPING; MATHEMATICAL ANALYSES; STATISTICAL ANALYSES

Category: MEASUREMENT METH

016875

ATMOSPHERIC AEROSOLS.
McCaldin, R. O., L. W. Johnson, and N. T. Stephens
Science, 166(3703):381-382, Oct. 17, 1969. 3 refs.
SCIENCE 1969
TECH Method of Support: NONE

Measurements of particle counts and size distributions of atmospheric aerosols have been made of various locations by use of an instrumented aircraft. The number of atmospheric particulates is related to the visibility. (Author's Abstract)

Descriptors: ARIZONA; AMERICA; NORTH AMERICA; UNITED STATES; FLORIDA; NEW MEXICO; TEXAS; HOUSTON; URBAN AREAS; METROPOLITAN AREAS; FORESTS; TOPOGRAPHIC LOCATIONS; OCEANS; BODIES OF WATER ; POLLUTANTS; PARTICULATES; AEROSOLS; SOURCES; INDUSTRIAL EMISSION SOURCES; STATIONARY EMISSION SOURCES; CHEMICAL PROCESSES; KRAFT (SULFATE) PULPING; MANUFACTURING INDUSTRIES; PAPER AND ALLIED MANUFACTURING; PULP MILLS; ELECTRIC POWER GENERATION; ELECTRIC, GAS, AND SANITARY SERVICES; NON-INDUSTRIAL EMISSION SOURCES (STATIONARY); OPEN BURNING; BURNING; TRANSPORTATION METHODS; MOBILE EMISSION SOURCES; AIRCRAFT; MEASUREMENT METHODS; PARTICLE COUNTING; PARTICLE INVESTIGATION METHODS; PARTICULATE CLASSIFICATION METHODS; PARTICLE SIZE; AEROSOL PHENOMENA; PARTICLE SIZE, SHAPE, AND STRUCTURE; PARTICULATE PROPERTIES; SAMPLING METHODS; PARTICULATE SAMPLING

Category: MEASUREMENT METH

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Radian Corp.,
Carbon monoxide field survey in downtown Houston, Texas, revised draft report.
DCN 77-100-044-16-03, EPA Contract No. 68-02-1383, Task 16.
Austin, TX, Radian Corp., May 1977.

*Carbon monoxide-air pollution; Houston, TX-air pollution; Air pollution monitoring;

Carbon monoxide concentrations in urban areas are affected by several factors. Because motor vehicles are the major source of CO emissions, traffic volume, vehicle speed and the condition (or absence) of vehicle emission control devices all affect CO levels. The dispersion of CO emissions is determined by air transport (ventilation) which can be severely restricted in downtown "street canyons." In a major metropolitan area such as Houston, Texas, high traffic volumes moving at slow speeds, through downtown streets bounded by tall buildings could produce high CO concentrations.

037683
THE C(12)/C(13) RATIO AS AN INDICATOR OF AIR POLLUTION.
Atkins, Patrick R.
Isotop. Radiat. Technol., 8(4):381-385, 1971. 15 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 1970, Paper CP 37C.)
ISOTOP RADIAT THECHNOL 1971
LAB FLD Method of Support: NONE

The use of stable isotopes of atmospheric constituents as natural tracers of pollutants and as indicators of general levels of pollution was investigated. Carbon dioxide samples were collected by freeze-out and precipitation procedures and the C(12)/C(13) ratios of the samples were determined. The ratio in atmospheric CO2 was calculated in several field tests and provided information about both the degree and influences of major sources of pollution in specified areas. Freeze-out sampling was less convenient but more reliable and probably more accurate than precipitation. The results of tests in Austin and Houston, Tex., on samples taken in traffic conditions and in a brewery, oil refinery, and steel mill are tabulated. Similar studies of nitrogen, oxygen, and sulfur could give information about the sources of sulfur oxides and nitrogen oxides present in polluted air. (Author abstract modified)

Descriptors: CARBON BLACK; CARBON; MATERIALS; FUELS; SOURCES ; STATIONARY EMISSION SOURCES; MEASUREMENT METHODS; SAMPLING METHODS; TRACERS; ATMOSPHERIC PHENOMENA; DISPERSION; PRECIPITATION; METEOROLOGY; CARBON DIOXIDE; OXIDES; FREEZING; CHEMICAL AND PHYSICAL PHENOMENA; COOLING; HEAT TRANSFER; ISOTOPES
Category: MEASUREMENT METH

026204

A CENTRALIZED INCINERATION FACILITY FOR INDUSTRIAL WASTE DISPOSAL.

Faatz, Albert C.

Water Sewage Works, 116(R.N.):R-197-R199, R201-R202, Nov. 28, 1969. 1 ref. (Presented at the National Pollution Control Conference and Exposition, 2nd Annual, Houston, Tex., April 22-24, 1969.)

WATER SEWAGE WORKS 1969

TECH Method of Support: NONE

An incineration facility to be constructed on the Houston Ship Channel will have a capacity of 15,000 tons of waste per month, representing about 20-25% of the quantity of waste from the area chemical plants available for treatment. The facility's location will make it available by barge, truck, or rail car. Incoming receipts will be divided into three categories. Those that can be atomized or otherwise converted into small particles will be treate in a 'liquid' furnace that is basically an adiabatic combustion chamber. Materials having large contents of ash or inorganic noncondensibles will be incinerated in a rotary hearth. Materials that are relatively large in size and those that burn slowly will be incinerated in a rotary kiln. Combustion gases from the three incinerators will be combined, then taken to a secondary combustion furnace where oxidation of potential or actual gas pollutants will be completed. This chamber is designed to combine the three essential elements of combustion--time, temperature, and turbulence--in such a manner as to complete burning of soot, hydrocarbon vapors, of sulfur-containing materials, and of odor or smog-producing compounds. Before passing to the stack, the combustion gases will be treated in a wet scrubber for the simultaneous removal of particulates, sulfur oxides, and hydrogen chloride. As pressures to conform to pollution control regulations become more severe, a centralized facility such as that described may be the only alternative to plant shut-down.

Descriptors: STACK GASES; POLLUTANTS; WASTE GASES; COMBUSTION GASES; COMBUSTION PRODUCTS; SOOT; PARTICULATES; SETTLING PARTICLES; FURNACES; SOURCES; STATIONARY EMISSION SOURCES; CHEMICAL PROCESSES; INDUSTRIAL EMISSION SOURCES; INCINERATORS (REFUSE); ELECTRIC, GAS, AND SANITARY SERVICES; REFUSE SYSTEMS; SANITARY SERVICES; KILNS; NON-INDUSTRIAL EMISSION SOURCES (STATIONARY); SCRUBBERS; CONTROL EQUIPMENT-GAS STREAMS; CONTROL EQUIPMENT - GAS STREAMS; SOX CONTROL; CONTROL METHODS; WASTE GAS CONTROL; DESIGN CRITERIA; HYDROCHLORIC ACID; ACIDS; INORGANIC ACIDS; HYDROCARBONS; SULFUR COMPOUNDS; OXIDATION; CHEMICAL AND PHYSICAL PHENOMENA; CHEMICAL REACTIONS; COMBUSTION

Category: CONTROL METHODS; EMISSION SOURCES

003477

CHARACTERISTICS AND DISTRIBUTIONS OF ORGANIC SUBSTANCES IN THE AIR OF SOME AMERICAN CITIES.

L. A. Chambers, E. C. Tabor, and M. J .Foter

A.M.A. Arch. Ind. Health 16, 17-26, July 1957. (Presented at the 48th Annual Meeting, Air Pollution Control Association, Detroit, Mich., May 23-26, 1955.)

AMA ARCH IND HEALTH 1957

FLD Method of Support: FELL GRT

A broad trend toward correlation between the average concentration of particulates and the size of population has been noted. In addition, seasonal loading distributions indicate that relatively high concentrations of particulates occur predominantly in the fall and winter seasons in cities throughout the nation, in spite of wide differences in household fuel use and winter heating requirements. The variations encountered with respect to the acetone-soluble fraction and preliminary efforts at analysis of these organic substances are discussed. The sampling program at present includes more than 30 metropolitan complexes in the United States and Alaska and 1 in England. Areas involved are: Anchorage, Alaska: Atlanta; Boston; Charleston, W. Va.; Chattanooga, Tenn.; Chicago; Cincinnati; Denver; Detroit; East Chicago, Ind.; Fort Worth, Texas; Frederick, Md.; Houston, Texas: Kansas City, Kan.; Kansas City, Mo.; London, England; Los Angeles; Louisville; Minneapolis; New Jersey (11 towns and cities); New Orleans; New York; Philadelphia; Portland, Ore.; Providence, R.I.; Salt Lake City; San Francisco; Tampa, Fla.; Washington, D.C.; Waterbury, Conn.; Windsor, Ontario.##

Descriptors: ALASKA; AMERICA; NORTH AMERICA; UNITED STATES; CALIFORNIA; LOS ANGELES; SAN FRANCISCO; COLORADO; CONNECTICUT; EUROPE; GREAT BRITAIN; UNITED KINGDOM; WESTERN EUROPE; LONDON; FLORIDA; GEORGIA; ATLANTA; ILLINOIS; CHICAGO; INDIANA; KANSAS; KENTUCKY; LOUISIANA; NEW ORLEANS; MARYLAND; MASSACHUSETTS; MICHIGAN; DETROIT; MISSOURI; NEW JERSEY; NEW YORK STATE; NEW YORK CITY; OHIO; CINCINNATI; OREGON; PENNSYLVANIA; PHILADELPHIA; RHODE ISLAND; TENNESSEE; TEXAS; URBAN AREAS; METROPOLITAN AREAS; UTAH; WASHINGTON D C; WEST VIRGINIA; POLLUTANTS; PARTICULATES; BERYLLIOSIS; DISEASES AND DISORDERS; AIR QUALITY MEASUREMENTS; CARCINOGENS; MEASUREMENT METHODS; SAMPLING METHODS; PARTICULATE SAMPLING; CZECHOSLOVAKIA; EASTERN EUROPE; MATHEMATICAL ANALYSES

Category: AIR QUALITY MEAS

Hidy, G.M., et al.,
Characterization of aerosols in California, final report, vol. I, revised.
Rockwell International Science Cntr., April 1975.

***Aerosols-properties; aerosols-analysis; aerosols formation; air pollution-monitoring;**

This report discusses the results of a major field study aimed at characterizing suspended particles (aerosols) in California air. Particular emphasis was placed on the haze identified with air pollution in the South Coast Air Basin. The program, named the ACHEX, was sponsored under California Legislative Bill No. 848.

The investigations were designed to use the newest techniques of measurement to characterize the aerosols in considerable detail. Several methods involving the determination of physical and chemical properties were developed and implemented during the course of the ACHEX.

Hidy, G.M., et al., Characterization of aerosols in California, final report, vols. 2, 3, and 4.
Rockwell International Science Cntr., Sept. 1974.

*Aerosols-properties; aerosols-analysis; aerosols-formation; aerosols-monitoring; air pollution;

Some of the more pressing questions of air pollution requiring improved knowledge are those dealing with aerosols. Although airborne particles represent a small fraction of the trace constituent loading in air, they contribute significantly to environmental degradation as a potential hazard to health, a visibility reducer, and a possible agent of weather modification. Despite many years of investigation, the origins and evolution of atmospheric aerosols remain poorly understood quantitatively, compared with trace gases. Recognizing this, the California Air Resources Board (ARB) sponsored the California Aerosol Characterization Experiment (ACHEX), a major experiment in air chemistry devoted to a detailed study of aerosols in urban and remote sites of California

005574

A COMPARISON OF PARTICULATE LOADINGS IN THE ATMOSPHERES OF CERTAIN AMERICAN CITIES.

L. A. Chambers, M. J. Foter, and J. Cholak

Proc. Natl. Air Pollution Symp., 3rd. Pasadena. Calif.. 1955. pp. 24-32.

PROC NATL AIR POLLUTION SYMP 3RD PASADENA CALIF 1955 1955

FLD PROC Method of Support: FELL GRT

A program of high-volume air sampling and analysis of particulate material was undertaken in a total of more than 30 cities. Each sampling site was chosen to represent the composite of air pollutants characteristic of an area. Each sample for analysis represents the total of particulate matter in sizes down to 0.3 micron removed from approximately 2.000 cubic meters of air during a 24 hour period. The results of particulate analyses are grouped in tables according to urban and nonurban areas, population, and size of city. Seasonal distribution in major cities is also graphically illustrated.##

Descriptors: ALASKA; AMERICA; NORTH AMERICA; UNITED STATES; CALIFORNIA; LOS ANGELES; SAN FRANCISCO; GEORGIA; ATLANTA; ILLINOIS; CHICAGO; KANSAS; KENTUCKY; MAINE; MARYLAND; MICHIGAN ; DETROIT; MISSISSIPPI; MISSOURI; NEW YORK STATE; NEW YORK CITY; OHIO; CINCINNATI; PENNSYLVANIA; PHILADELPHIA; TEXAS; HOUSTON; UTAH; WEST VIRGINIA; NON-METROPOLITAN AREAS; URBAN AREAS; METROPOLITAN AREAS; POLLUTANTS; PARTICULATES; ARSENIC COMPOUNDS; CHLORINE COMPOUNDS; FLUORINE COMPOUNDS; METAL COMPOUNDS; BERYLLIUM COMPOUNDS; CHROMIUM COMPOUNDS; COPPER COMPOUNDS; IRON COMPOUNDS; LEAD COMPOUNDS; MAGNESIUM COMPOUNDS ; MANGANESE COMPOUNDS; SILVER COMPOUNDS; SODIUM COMPOUNDS; STRONTIUM COMPOUNDS; TITANIUM COMPOUNDS; VANADIUM COMPOUNDS; ZINC COMPOUNDS; NITRATES; POTASSIUM COMPOUNDS; SULFUR COMPOUNDS; SULFATES; ADMINISTRATION; PLANS AND PROGRAMS; AIR QUALITY MEASUREMENT PROGRAMS; AREA SURVEYS; AIR QUALITY MEASUREMENTS

Category: AIR QUALITY MEAS

Texas Air Control Board,
Continuous Monitoring Network Data Summary, annual reports for 1974 through 1977. Austin, TX.

Kamens, Richard M. and Harvey E. Jeffries,
A critical review of ambient air aldehyde measurement methods and an analysis of Houston aldehyde data, part 1, review of measurement methods.
Chapel Hill, NC, University of North Carolina, Dept. of Environmental Sciences and Engineering, undated.

Air quality data; Photochemical pollutants-monitoring; *Aldehydes-air **pollution**; Houston, Tx.-air pollution; Texas-air pollution;

Aldehydes are a group of compounds which have double bonded oxygen atoms on a terminal carbon atom of an organic molecule. They are often represented chemically as R-CHO, where R is either a hydrocarbon atom or a saturated or unsaturated organic group. Formaldehyde, the first member of the aliphatic (saturated) homologous group, has the chemical formula of H-CHO. Acetaldehyde, the next member, has the formula CH_3-CHO and propionaldehyde, the third, CH_3-CH_2-CHO. Acrolein, the smallest unsaturated aldehyde, has a structure similar to propionaldehyde except that a double bond appears between the first and second carbon atoms, CH_2=CH-CHO. A list of saturated and unsaturated aldehydes along with boiling points, toxicities, and uses is given in Appendix A (Stahl, 1969).

044234
DIFFERENCES IN METAL AREAL DISTRIBUTION DISPLAYED BY TREND-SURFACE ANALYSIS.
Severs, Richard K. and Leslie A. Chambers
Arch Environ. Health, 25(2):139-145, Aug. 1972. 8 refs.
ARCH ENVIRON HEALTH 1972
FLD Method of Support: NONE

Trend-surface computer maps were prepared to estimate the areal concentration isopleths of cadmium, copper, magnesium, manganese, lead, and zinc, suspended particulates, and the associated benzene- soluble concentrations which occurred on April 13, 1970. The samples were collected from a 17-station ambient air surveillance network in Houston and then analyzed.

A comparison of maps indicates important areal differences in the distribution of all pollutants. Suggestions are made as to how these maps could be used for further studies based on areal data. (Author abstract modified)

Descriptors: AREA SURVEYS; ADMINISTRATION; AIR QUALITY MEASUREMENT PROGRAMS; PLANS AND PROGRAMS; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; URBAN AREAS; METROPOLITAN

AREAS; SUSPENDED PARTICULATES; PARTICULATES; POLLUTANTS; BENZENE-SOLUBLE ORGANIC MATTER; CHEMICAL COMPOSITION; AIR QUALITY MEASUREMENTS; COMPUTERS; MAPPING; METAL COMPOUNDS; CADMIUM COMPOUNDS; COPPER COMPOUNDS; LEAD COMPOUNDS; MAGNESIUM COMPOUNDS; MANGANESE COMPOUNDS; ZINC COMPOUNDS

Category: AIR QUALITY MEAS

024227

THE DISTRIBUTION OF MN AND BR IN AN URBAN AREA AS REVEALED THROUGH ACTIVATION ANALYSIS.

Randerson, Darryl

Atmos. Environ., 4(3):249-257, May 1970. 8 refs.

ATMOS ENVIRON 1970

FLD Method of Support: RES GRT

In an attempt to identify some of the components of air pollution in Houston, fifteen high-volume samplers were operated continuously for 24-hr periods. The major industries in Houston consist of oil refineries and petrochemical plants as well as secondary manufacturers such as steel mills, fertilizer companies, and paper mills. Filter papers from one day of sampling were irradiated in a thermal neutron flux and the resulting radio- nuclides were identified. Manganese and bromine were detected. The primary source of Mn compounds probably would be process losses from cement companies, chemical companies, and a steel mill located upwind from the sampling stations, while it is proposed that the Br compounds may have originated from ethyl fuel combustion. During one 24-hr period, the concentrations of Mn ranged from 0.02 to 0.56 micrograms inverse cu m while those of Br ranged from 0.04 to 1.09 micrograms inverse cu m. The spatial distributions of these two elements were related to the meteorological conditions. Patterns of concentration appeared to be related to the predominant direction of wind. Depending on the elements to be detected, the average cost per sample is estimated to be between $50 and $100. (Author abstract modified)

Descriptors: COSTS; ECONOMICS; CEMENTS; CONSTRUCTION MATERIALS; MATERIALS; STEEL; IRON; METALS; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; ENGINE EMISSIONS; POLLUTANTS; CHEMICAL PROCESSES; INDUSTRIAL EMISSION SOURCES; SOURCES; STATIONARY EMISSION SOURCES; PETROLEUM REFINING; MANUFACTURING INDUSTRIES; PETROLEUM AND COAL PRODUCTS INDUSTRY ; AGRICULTURAL CHEMICAL PLANTS; CHEMICALS AND ALLIED MANUFACTURING; PAPER MILLS; PAPER AND ALLIED MANUFACTURING; PETROLEUM PRODUCTION; MINING; AIR QUALITY MEASUREMENTS; NEUTRON ACTIVATION ANALYSIS; ANALYTICAL METHODS; CONTINUOUS MONITORING; MEASUREMENT METHODS; MONITORING; HI-VOL SAMPLERS; SAMPLERS; SAMPLING METHODS; METEOROLOGY; ATMOSPHERIC PHENOMENA ; WINDS; ATMOSPHERIC MOVEMENTS; BROMINE; HALOGEN GASES; MANGANESE COMPOUNDS; METAL COMPOUNDS

Category: MEASUREMENT METH; EMISSION SOURCES; AIR QUALITY MEAS

055165
EVALUATION OF MEASUREMENT METHODS AND INSTRUMENTATION FOR ODOROUS COMPOUNDS IN STATIONARY SOURCES. VOL. II, FIELD TESTING. (FINAL REPORT JUNE 1971 TO DEC 31, 1972).
Hall, H. J.
Esso Research and Engineering Company, Linden, N. J., Government Research Lab., Environmental Protection Agency Contract 68-02-0219, EPA-R2- 73-180, Program Element 1A1010, GRU.2DJAB.73, 161p., March 1973. 7 refs.
1973
FLD Method of Support: CONTRACT
USGRDR No.: NTIS, PB 223654/AS

Various instruments which are commercially available for the measurement of hydrogen sulfide and reduced-sulfur odorants in stack emissions were evaluated under field conditions. None of the instruments tested was able to provide a routine analysis for H2S/TRS or for individual S compounds at emission levels in both the refinery and pulp mill tests. The Barton coulometer has given satisfactory field service for years in a number of kraft paper mills. It cannot give absolute values and readings are directly proportional to sample flow rate; the addition of a flow rate controller is recommended. The system cannot be depended on to define the amount or absence of either H2S or sulfur dioxide at 1 ppm or less in the presence of 10 ppm of the other, nor can it measure either total S or total reduced S compounds correctly in the presence of SO2 and COS or CS2. The Bendix gas chromatograph/Flame photometric detector has a more stable zero and superior stability compared with the Barton. With a 1 cc sample, the upper limit of linearity is 30 to 50 ppm for carbonyl sulfide and 80 to 120 ppm for H2S, SO2, and methyl mercaptan. The instrument requires skilled maintenance. The Houston Atlas system for sample pyrolysis and catalytic reduction to H2S is promising for further development and suitable for use with a simple tape sensor; its operation was basically satisfactory. Minimum requirements for future instruments are specified.

Descriptors: STACK GASES; POLLUTANTS; WASTE GASES; COMBUSTION GASES; COMBUSTION PRODUCTS; PETROLEUM REFINING; INDUSTRIAL EMISSION SOURCES; MANUFACTURING INDUSTRIES; PETROLEUM AND COAL PRODUCTS INDUSTRY; SOURCES; STATIONARY EMISSION SOURCES; CHEMICAL PROCESSES; KRAFT (SULFATE) PULPING; PAPER AND ALLIED MANUFACTURING; PULP MILLS; POTENTIOMETRIC METHODS; ANALYTICAL METHODS; CHEMICAL METHODS; ELECTROCHEMICAL METHODS; FLAME IONIZATION DETECTOR (CO); CHROMATOGRAPHY; GAS CHROMATOGRAPHY; MONITORING; MEASUREMENT METHODS; PHOTOMETRIC METHODS; GAS SAMPLING; SAMPLING METHODS; SOURCE MONITORING; FIELD TESTS; INSTRUMENTATION; MERCAPTANS; SULFUR ORGANIC COMPOUNDS; SULFUR DIOXIDE; OXIDES; SULFUR OXIDES; HYDROGEN SULFIDE; SULFIDES; SULFUR COMPOUNDS; POTENTIOMETRIC METHODS
Identifiers: COULOMETRY
Category: MEASUREMENT METH

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MONITORING

Radian Corp.,
HAOS aldehydes monitoring program.
DCN 78-100-169-02, HAOS Contract No. Ox-6.
Austin, TX, April 1978.

Houston, Texas-air pollution; Texas-air pollution; *Aldehydes-sampling; Gas chromatography-applications; Air pollution-monitoring;

One-hour samples were collected for total aldehydes and formaldehyde analysis at two sites in Houston from 5 a.m. to 5 p.m. (CDT) during the period from August 3 to October 13, 1977. Additionally, 3-hour samples were taken four times a day for a ten-day period at each site and analyzed for C_2-C_6 aldehydes on a gas chromatograph.

Of the 295 samples analyzed for total aldehydes at Aldine, 65 percent were below the minimum detectable levels (Table V-1), while 94 percent of the formaldehyde samples at Aldine were below the minimum detectable levels (Table V-2). Of the 353 samples from Fuqua analyzed for total aldehydes, 58 percent were below the minimum detectable levels (Table V-3), and 96 percent of the 255 samples analyzed for formaldehyde at Fuqua were below the minimum detectable levels (Table V-4). The maximum value reported for total aldehydes is 63 $\mu g/m^3$ measured at Aldine. The highest formaldehyde value reported is 16 $\mu g/m^3$ at Aldine.

For the detailed sampling for C_2-C_6 aldehydes, all samples were below the minimum detectable level for the chromatographic analysis.

From Tables V-1 through V-4, it appears that total aldehydes were present, but in low concentrations. Formaldehyde was the major constituent of the total aldehydes on some occasions, but not always.

Jones, D.C.,
Hydrocarbon sampling, final report.
DCN 78-100-171-01, HAOS Contract No. HCP-5b.
Austin, TX, Radian Corp., Feb. 1978.

Hydrocarbons-sampling; Texas-air pollution; *Houston, Texas-air pollution; Sampling and sample handling;

Hydrocarbon samples were collected in stainless steel cans by Radian Corporation. Clean, evacuated cans were supplied by Research Triangle Institute. After sampling the cans were returned to Research Triangle Institute for detailed hydrocarbon analysis.

Samples were collected daily from 6:00 to 9:00 a.m. on a daily basis at one of three primary sampling sites. Special samples also were collected. During pollution episodes, upwind-downwind and/or areawide samples were collected. In addition, special samples were collected in a forest and at an offshore oil well platform. Samples also were collected from an aircraft.

057195
IMPROVED TITRILOG SENSITIVITY. PART II. FIELD PERFORMANCE AND EVALUATION.
McKee, Herbert C. and William L. Rollwitz
J. Air Pollution Control Assoc., 8(4):338-340, Feb. 1959. 1 ref.
J AIR POLLUTION CONTROL ASSOC 1959
LAB FLD Method of Support: NONE
Since sulfur dioxide was considered to be the best single indicator of overall air-pollution levels in Houston, a Titrilog was modified for actual field use in recording the variation in the SO2 concentrations in different sections of the city. Increasing the instrument s sensitivity by a factor of 10 introduced noise and drift problems, the first of which was corrected by reducing the bandwidth of the input circuit with a simple BC low-pass filter. To correct the drift, the zero-suppression of the Titrilog was adjusted so that pure air on the reading was 20 to 30. In actual operation, drift of the zero point beyond the lower end of the scale was the most serious difficulty, and the instrument was set to record a zero reading once an hour. For field use, the Titrilog was installed in a small trailer readily moved to wherever 110-v power was available. The instrument required a minimum of maintenance. Inspection can be limited to twice a week.
Descriptors: PORTABLE; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; URBAN AREAS; METROPOLITAN AREAS; AIR QUALITY MEASUREMENTS; ANALYTICAL METHODS; DESIGN CRITERIA; FIELD TESTS; INSTRUMENTATION; RECORDING METHODS; SULFUR DIOXIDE; OXIDES; SULFUR OXIDES; RECORDING METHODS
Identifiers: YEAR 1959; TITRILOG
Category: MEASUREMENT METH

BIBLIOGRAPHY (continued)
MONITORING

Leaderer, Brian P., et al.,
"Light scattering measurements of the New York Summer Aerosol",
Presented at the American Industrial Hygiene Conference, New Orleans, LA, May 1977.

Continuous hourly light scattering measurements taken during July and August 1976 as part of the New York Summer Aerosol Study (NYSAS) are presented. Long-path light extinction measurements were taken at 0.4416μm utilizing a laser transmissometer system employing a He-Cd laser. The extinction coefficient for scattered light, as an index for visibility, was measured and the hourly total volume of particles between 0.1μm and 1.3μm (the size range associate with visible light scattering) were calculated from number size distribution measurements. A strong relationship was observed between light scattering and water soluble sulfates indicating that sulfates dominated light scattering in the New York summer aerosol.

Westberg, H., K. Allwine and E. Robinson,
Measurement of light hydrocarbons and studies of oxidant transport beyond urban areas, Houston Study - 1976, final report.
EPA Contract No. 68-02-2298.
Pullman, WA, Washington State University, Chemical Engineering Dept., May 1978.

During the month of July, 1976, Washington State University carried out an extensive air pollutant monitoring program in the Houston area. This field study involved ground sampling plus use of an instrumented aircraft. Measurements included ozone, oxides of nitrogen, PAN, methane, carbon monoxide, individual hydrocarbons (C_2-C_{10}), halocarbons, condensation nuclei and visual distance plus numerous meteorological parameters. Specific areas of interest in this study included; 1) oxidant formation and transport within the Houston urban plume, 2) relationships between ozone layers aloft and the vertical temperature profile, 3) composition and effects of refinery and petrochemical emissions on the local Houston air mass, and 4) identification and quantitation of individual C_2-C_{10} hydrocarbons in the Houston atmosphere. Results of this field program are presented with special emphasis placed on oxidant production and transport in the Houston area.

102709
Measurements of Photodegraded C2-C5 Hydrocarbons from Aerosol Particulates Collected in Houston, Texas
Nahm, James J. W.
'Ozone/Oxidants Interactions with Total Environ. pp. 157-165 Pittsburgh, Pa., Air Pollution Control Assoc. 1978
Doc Type: C: ORIGINAL (LABORATORY)
CAS Registry No: 74-85-1 115-07-1 624-64-6 106-98-9 115-11-7
The photodegradation of aerosol particulates by ultraviolet radiation was investigated in conjunction with the measurements of desorbed C2-C5 hydrocarbons (HC) from aerosol particulates. Particulates containing adsorbed hydrocarbons were irradiated in an ultrapure nitrogen environment with artificial UV radiation sources, having maximum emission at 3550 A and 2535 A. After irradiation, the particulates released hydrocarbons with compositions quite different from hydrocarbons desorbed under similar conditions without irradiation. A 30-min irradiation of particulates with two 15-W black lamps yielded 60 nl/gm total hydrocarbons with 50% olefins and a two-hour irradiation with two 15-W mercury lamps yields 11,000 nl/gm with 70% olefins. A nine-month measurement of atmospheric hydrocarbons in the Houston area indicates that an average value of the olefin content is 23%. The major products from the photodegradation are ethylene and propylene. Small amounts of C4 olefins such as 1-butene, isobutylene and t-butene-2 are also present in the photodegraded hydrocarbons. (16 Refs)
Descriptors: AEROSOLS; PARTICULATES; POLLUTANTS; BUTENES; ETHYLENE; OLEFINS; ALIPHATIC HYDROCARBONS; HYDROCARBONS; PHOTOCHEMICAL REACTIONS; CHEMICAL REACTIONS; CHEMICAL AND PHYSICAL PHENOMENA; ULTRAVIOLET RADIATION; LIGHT RADIATION; CHEMICAL AND PHYSICAL PHENOMENA
Category: BASIC SCIENCE AND TECHNOLOGY

Radian Corp.,
Monthly air monitoring report Houston Lighting and Power Company twelve station network July 1974, report No. 1.
Radian Project No. 100-047, Houston Lighting and Power Contract.
Austin, TX, Oct. 1974.

SO_2-air pollution; Air pollution-particulate emissions-monitoring; NO_x-air pollution; Air pollution-monitoring; *Houston, Texas-air pollution; Air pollution-meteorological factors;

Radian Corporation is under contract to Houston Lighting and Power Company to provide ambient air quality monitoring at twelve locations in the Houston metropolitan area. Each monitoring station senses and records concentrations for particulates, nitrogen oxides, and sulfur dioxide. Various meteorological parameters such as wind speed, wind direction, temperature and relative humidity are monitored also. The data provides useful information regarding pollution concentration and their correlation to varying meteorological conditions.

104336

A New Adsorbent for the Concentration and Analysis of Volatile Organic Compounds in the Environment

Zlatkis, Albert; Bertsch, Wolfgang

Public Health Service, Washington, D. C., National Inst. for Occupational Safety and Health

NIOSH Solid Sorbents Roundtable, Second, Cincinnati, Ohio, 1973 pp. 107-120, July 1976

Note: (Dec. 5-6.) (E. Vernon Ballou, ed.)

Doc Type: U; Original (Laboratory)

Report No.: Rept. HEW (NIOSH) 76-193

A new adsorbent, Tenax GC (2,6-diphenyl-p-phenylene oxide), for the concentration and analysis of volatile organic compounds in the environment, is described. Experimental work on the analysis of flavors utilizing Tenax GC revealed that Tenax GC fulfilled both requirements of efficient adsorptivity and desorptivity, as it can sustain relatively high temperatures (375 C limit). Samples were desorbed at 200-300 C with good reproducibility, and regeneration was effected at 375 C. Tenax GC was evaluated for air analysis. Samples considered to be representative of urban, industrial, and agricultural environments were taken at various locations around Houston, Texas. Approximately 100 substances, almost exclusively hydrocarbons, were identified by mass spectrometry. Alkanes represented the major part, especially at the low molecular weight end of the spectrum, whereas substituted aromatics were more abundant for the high molecular weight end. As expected, automobiles are the major source of volatiles in the air. This work is being continued and the principles of selective detection and selective adsorption will be applied to substances of physiological interest. (7 Refs)

Descriptors: Pollutants; Air Quality Measurements; Chemical Composition; Combustibles and Volatiles; Analytical Methods; Spectrometry; Mass Spectrometry; Sampling Methods; Samplers; Chemical and Physical Phenomena; Adsorption Phenomena; Chemical and Physical Properties; Temperture; Volatility; Weight; Sources; Mobile Emission Sources; Transportation Methods; Motor Vehicle Sources;, Light-Duty Vehicles; Automobiles; America; North America; United States; Texas; Houston; Industrial Areas; Metropolitan Areas; Urban Areas; Non-Metropolitan Areas; Farms; Hydrocarbons; Aliphatic Hydrocarbons; Cyclic Alkanes; Aromatic Hydrocarbons

Category: Measurement Methods (Categorical); Measurement Methods (Ambient Air and Emissions)

Laird, A.R. and R.W. Miksad,
"Observations on the particulate chlorine distribution in the Houston-Galvaston area",
Atmos. Env. 12, 1537-42 (1978).

Abstract—The chlorine component of total suspended particulate (TSP) measured in the Houston–Galveston area during 10 days in June and September, 1975 has been examined for spatial variation and correlation with wind speed. The background concentrations of chlorine vary over an order of magnitude (from 0.2 to 6.6 $\mu g\,m^{-3}$), and are found to depend on wind speed and direction. Higher background concentrations are associated with inland penetration of fresh marine air from the Gulf of Mexico. These background [Cl] variations are taken into account in order to identify anthropogenic [Cl] sources. Significant non-marine sources of [Cl], located in the industrialized Pasadena–Houston Ship Channel area, are evident in our data.

Worley, F.L., Jr., A.A. Siddiqi, and L.R. LaMotte,
Ozone episode documentation project report.
Houston, TX, University of Houston, April 1977.

Air quality data; *Houston, TX-air pollution; Air pollution-sources-mobile; Ozone-air pollution;

Manual and computer aided analysis of the Texas Air Control Board (TACB) continuous monitoring station data (1975) plus selected City of Houston data has been carried out. This report describes data handling procedures, statistical methods employed and presents observations and correlations developed using the data. Problems related to completeness of data sets and inadequate meteorological data are discussed.

The more significant findings center around the apparent major role played by non-stationary sources in determining the maximum daily ozone concentration. This effect was observed time and again and gives strong emphasis to the impact of vehicular sources in this state. Analysis of episode periods does not provide any verification that frontal passage has a major role. The dominant meterological variable appears to be local wind speed, i.e. extended periods of low wind speed are necessary for high ozone levels. A secondary observation involves subsidence of stratospheric air and appears to preceed episodes.

Caution is recommended in using the above correlations and observations because the sample size is quite small and as a result statistically not reliable.

Johnson, Carl E., et al., Ozone Concentrations Along the Upper Texas Gulf Coast April, May, June 1972, 2nd ed., Austin, Tx., Texas State Department of Health, Air Pollution Control Services, Air Quality Evaluation Program, Aug. 1972.

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Wallis, Roger R., et al., Ozone Concentrations in Rural and Industrial-Urban Centers in Texas, Austin, Tx., Texas Air Control Board, March 1975.

Johnson, Carl E., Duane J. Johnson, and Roger R. Wallis, Ozone Concentrations on the Upper Texas Gulf Coast July, August, September, 1972, Austin, Tx., Texas State Department of Health, Air Pollution Control Services, Air Quality Evaluation Program, March 1973.

Radian Corp.,
Ozone/ultraviolet radiation monitoring, final report.
DCN 78-100-170-03, HAOS Contract No. OX-4B.
Austin, TX, June 1978.

Air pollution-monitoring; Ozone-monitoring; Radiation-monitoring; *Houston, TX-air pollution;

As part of the Houston Area Oxidant Study, Radian Corporation monitored ambient levels of ozone and ultraviolet radiation at a site northwest of Houston, Texas. The monitoring was performed from June 15, 1977 to October 31, 1977.

The monitoring site was graciously supplied by the Houston Lighting and Power Company for whom Radian had been operating a monitoring station at the site. A modified ambient air quality monitoring station with the added capabilities for ozone and ultraviolet radiation was deployed to replace the existing station.

058386
PARTICULATE MASS AS A PREDICTOR OF NUMBERS OF RESPIRABLE PARTICULATES.
Severs, R. K. and C. T. Chen
Chemosphere, 2(5):199-200, 1973. 4 refs.
CHEMOSPHERE 1973
THEO FLD Method of Support: NONE
The mass of suspended particulates in air was investigated as a predictor of the number of respirable particulates. Nephelometric measurements were made at several sites in Houston, Tex., on Aug. 23, 25, 28, 1972 and 24-hour high-volume air samples of suspended particulates were taken Aug. 19, 25, 31 at the same sites. A linear regressions model was assumed with the number of respirable particulates per

volume of air the dependent variable, and suspended particulate mass per volume of air the regressor variable. The correlation efficient (c) between suspended particulate mass and the number of respirable particulates found at the various sites on Aug. 25 was 0.87 and the least squares estimate (s) was 1.79. For the 12-day average period, Aug. 19-31 at the same sites (r) was 0.90 and (s) was much smaller at 0.57. Suspended particulate mass is a good predictor of the number of respirable particulates over a fairly long period, however, daily variance is too large to allow prediction of the number of particulates at any one site on a daily basis.

Descriptors: DUSTS; PARTICULATES; POLLUTANTS; SETTLING PARTICLES; SUSPENDED PARTICULATES; AIR QUALITY MEASUREMENTS; STATISTICAL ANALYSES; AIR POLLUTION FORECASTING; ATMOSPHERIC PHENOMENA

Category: AIR QUALITY MEAS

080563

PHOTOCHEMICAL OXIDANTS, AEROSOL, AND OPTICAL DEPTH.

Severs, R. K. and J. C. Peng

Chemosphere, 4(5):265-270, Oct. 1975. 12 refs.

CHEMOSPHERE 1975

FLD Method of Support: NONE

The relationship between optical depth and photochemical oxidants and aerosols was investigated. Simultaneous measurements of ground level ozone concentration and optical depth due to light scattering by aerosols (T P) at various wavelengths indicated a distinct relationship between levels of O3 greater than 0.1 ppm by volume and the difference in the optical depth profile between 0.3800 and 0.5000 micron, when T P is greater than some predetermined value characteristic of the area or region. This relationship is attributed to aerosol growth which accompanies photochemical smog formation.

Optical depth measurements at various wavelengths are proposed as a unique method to indicate the intensity of photochemical smog. Comparison of the T P data collected in Houston with the standard background aerosol optical depth data indicate that the probability of photochemical smog formation is quite low when T P (.5000) less than .20 since the characteristic shape of the function is still conserved with the recognizable minimum at 0.6000 micron. A positive change between T P (.3800) and T P (.5000) indicates a low probability for the presence of a photochemical aerosol formation. Criteria were established which may indicate the degree of photochemical aerosol formation.

Descriptors: OXIDANTS; POLLUTANTS; AEROSOLS; PARTICULATES; SMOG; SUSPENDED PARTICULATES; OPTICAL METHODS; MEASUREMENT METHODS; OZONE; LIGHT SCATTERING; CHEMICAL AND PHYSICAL PHENOMENA; OPTICAL PROPERTIES; CHEMICAL AND PHYSICAL PROPERTIES

Category: MEASUREMENT METH

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Regional Atlas, 1972.
Houston, TX, 1972.

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Houston - Galveston Area Council,
Regional data book. Vol. 1.
Houston, TX, 1972.

Houston, TX;

102738
A Review of the Relationship between Ambient Total Non-Methane Hydrocarbon Concentrations and Ambient Ozone Levels in Houston
MacKenzie, Kenneth; Wenzel, Lawrence
Ozone/Oxidants Interactions with Total Environ. pp. 38-49
Pittsburgh, Pa., Air Pollution Control Assoc. 1976
Doc Type: C: REVIEWS (TECHNICAL)
CAS Registry No: 10028-15-6
Measurements of ozone (O3) and non-methane hydrocarbons are reviewed from May through October 1975. This period was selected because the photochemical oxidant standard of 0.08 ppm was often exceeded. Correlation coefficients between O3 and non-methane hydrocarbons were determined, and no direct relationship was found. Much more air quality information and air quality analysis needs to be performed in the Houston area in order to better develop realistic control strategies for reducing O3 levels. A review of the measurement limitations of both the non-methane hydrocarbon and O3 equipment needs to be conducted to ensure that the values reported are reliable. A photochemical oxidant model needs to be developed for Houston so that strategies can be tested prior to application. (8 Refs)
Descriptors: AIR QUALITY MEASUREMENTS; HYDROCARBONS; NON-METHANE HYDROCARBONS; CHEMICAL COMPOSITION; OXIDANTS; POLLUTANTS; OZONE; TEXAS; UNITED STATES; NORTH AMERICA; AMERICA
Category: ATMOSPHERIC INTERACTION (METEOROL AND CLIMATOL AND TOPOGR); ATMOSPHERIC INTERACTION; POLLUTION DATA (AIR QUALITY MEASUREMENTS); POLLUTION DATA

065595
SIMULTANEOUS TOTAL OXIDANT AND CHEMILUMINESCENT OZONE MEASUREMENTS IN AMBIENT AIR.
Severs, Richard K.
Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1974. 15 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 35.1.)
AIR POLLUTION CONTROL ASSOC ANNU MEET 67TH DENVER COLO 1974 1974
FLD Method of Support: RES GRT
Ambient air quality measurements taken by the total oxidant method and the chemiluminescent method are compared. The buffered potassium iodide method for measuring total oxidants and the chemiluminescent method for ozone were run simultaneously from August through December 1973, side by side at a site on the Houston ship channel. They were calibrated daily. Hourly averages were analyzed by linear regression and the confidence intervals were calculated, as well as confidence intervals for point estimates. These methods were used with all data sets with values greater than 10 ppb and again with values greater than 30 ppb. A regression line was also calculated for another set of data for the preceding year. These data were generated before a chromium trioxide scrubber was installed to eliminate possible chemical interferences with the KI method. The chemiluminescent method tends to produce values as much as two times higher than the simultaneous total oxidant values. An 80 ppb chemiluminescent ozone value predicted a value of 78 ppb total oxidant with a 95% confidence interval of 0.4 to 156 ppb. Statistical analyses confirmed that either measurement was a very poor predictor of the other. Enforcement of primary air quality standards with a reference method different than that used to establish the standard is thus questioned.
Descriptors: EFFICIENCY; AIR QUALITY STANDARDS; STANDARDS; OXIDANTS; POLLUTANTS; AIR QUALITY MEASUREMENTS; IODIMETRIC METHODS; ANALYTICAL METHODS; CHEMICAL METHODS; MONITORING; MEASUREMENT METHODS; STATISTICAL ANALYSES; OZONE
Category: MEASUREMENT METH

Lippmann, Morton, **et al.**,
"Size-mass distributions of the New York Summer Aerosol",
Presented at the American Industrial Hygiene Conference, New Orleans, LA, May 1977.

Size-mass distributions and overall mass concentrations of the New York City summer ambient aerosol were determined by a variety of sampling and analytical techniques. For gravimetric analyses, 24-hour samples were collected daily with high-volume cascade impactors and constant-flow single stage high-volume filters. Seven-day samples were collected with a high-volume parallel, flow particle size classifier, which contains four cyclone-filter 2-stage samplers and a total mass filter. One-hour total mass concentration determinations were made with a β-attenuation mass monitor, and one-minute determinations were made with a quartz-crystal microbalance mass monitor. The results of all of the various size-mass distribution

and mass concentration measurements are summarized and intercompared with each other and with estimates based on the measurement of other parameters; particle volume distributions obtained from an electric aerosol analyzer and optical particle counter, and b-scat values obtained with a nephelometer.

006422
A STUDY OF AIR POLLUTION SOURCES AS VIEWED BY EARTH SATELLITES.
Randerson, Darryl
J. Air Pollution Control Assoc., 18(4):249-253. April 1968. (Presented at the 60th Annual Meeting. Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967, Paper 67-129.)
J AIR POLLUTION CONTROL ASSOC 1967
TECH Method of Support: FELL GRT

Several Gemini photographs of smoke plumes were analyzed and related to the local weather conditions. A space craft view of a forest fire in the Apalachicola National Forest revealed a rather large smoke plume. Geometrically scaled measurements indicated the plume was approximately 4 miles wide and about 65 miles long. Trapped under a frontal inversion located between 2,500 and 3,000 feet above ground level, this plume was being advected south-southwestward into the Gulf of Mexico by the local wind flow pattern. Several pictures containing examples of industrial smoke plumes in the vicinity of Houston, Texas, are discussed in relation to the local synoptic situation. A picture of industrial haze over Houston, Texas, is presented to illustrate an areal distribution of atmospheric pollutants covering an area of about 2,600 square miles. Satellite photographs of air pollution are helpful in determining a pollutant source region. Such pictures could be used to determine whether or not the pollution is interstate or intrastate. This information might be useful for enforcing future clean air legislation. (Author's abstract, modified)##

Descriptors: ALABAMA; AMERICA; NORTH AMERICA; UNITED STATES; FLORIDA; LOUISIANA; TEXAS; HOUSTON; FORESTS; TOPOGRAPHIC LOCATIONS; POLLUTANTS; PARTICULATES; SUSPENDED PARTICULATES; SMOKES; SOURCES; INDUSTRIAL EMISSION SOURCES; STATIONARY EMISSION SOURCES; SPACECRAFT ATMOSPHERES; CONTROLLED ATMOSPHERES; CAMERAS; RECORDING METHODS; PHOTOGRAPHIC METHODS; ATMOSPHERIC PHENOMENA; ALTITUDE; LOWER ATMOSPHERE; DISPERSION; PLUME BEHAVIOR; METEOROLOGY; ATMOSPHERIC MOVEMENTS; ADVECTION; WINDS; CAMERAS; SPACECRAFT
Identifiers: SATELLITES; PHOTOGRAPHS; GEMINI XI, VII
Category: ATMOS INTERACT; MEASUREMENT METH

English, Glenn H.,
Study of carbon monoxide exceedance levels in Houston during 1972-1973 calendar years and January-April 1974.
Houston, Tx., Texas Highway Dept., Houston Urban Office, Feb. 1975.

Carbon monoxide-air pollution; *Houston, Tx.-air polluton; Texas-air pollutic
Highways-air pollution;

BIBLIOGRAPHY (continued)
MONITORING

This report covers a study of Carbon Monoxide(CO) concentrations in the atmosphere of Houston from January, 1972 through April, 1974 at the only three continuously monitoring sites the City had at that time. The study was made for the one-hour average standard[1](level exceeded only once) and the eight-hour average standard[2](level exceeded 15 times). These periods were examined for relationship to traffic volume, natural gas consumption rate, wind speed and ambient temperature. A related study was also made comparing the mortality rates of Houston, Texas and other states, and the United States.

Texas, State of, Department of Health, Air Control Section,
Study of suspended particulate measurements at varying heights above ground.
Austin, TX, 1970.

*Air pollution-particulate emissions-monitoring;

Statistical analysis of the data described revealed that concentrations of suspended particulate did decrease with height above ground level and that this decrease is both significant and predictable (See Table 5). Measured 3' height concentrations were found to have a high degree of relationship with values obtained at both 17 and 29 feet. The decreases in concentrations of suspended particulate with increased height of samplers may be partially attributable to variances in high volume sampler performance. Table 6 is a resume of results from a test to compare measurements of high volume samplers. The variation obtained in concentrations measured with different high volume samplers during this test closely approximated the amount of change associated with height increases for the height study. It should be kept in mind however, that in all cases, the changes in concentration obtained by varying sampler height showed decreases with height. While the number of samples used in this study was not large, it was sufficient to provide a reasonable assurance that variances between samplers would tend to cancel out.

080838
A STUDY ON THE DETERMINATION OF THE ATMOSPHERIC AEROSOL CONTENT USING ERTS DATA (FINAL REPORT).
Griggs, M.
Science Applications, Inc., La Jolla, Calif., National Oceanic and Atmospheric Administration Contract 4-35365, Rept. SAI-75-566-LJ, 16p., April 17, 1975. 2 refs.
1975
FLD Method of Support: NONE
Further data points were sought for relating radiance and aerosol content by finding coincidences between Earth Resources Technology Satellite (ERTS) data and aerosol data obtained routinely by the National Oceanic and Atmospheric Administration-Environmental Protection Agency turbidity network, with emphasis on high aerosol contents, and conditions of possible sun glitter. Seven turbidity network sites, plus the National Aeronautics and Space Administration Houston area network, were identified as being near to bodies of water, and hence suitable for relating ERTS data and

turbidity data. Twenty four coincidences of ERTS and turbidity data were found; of these, four were high aerosol contents. Examination of the ERTS black and white prints of these 4 days revealed that two of them will aid in checking the relationship between radiance and aerosol content where data points are presently sparse. The lower turbidity values are useful for providing statistical support of the existing data. (Author abstract modified)

Descriptors: SATELLITES (ARTIFICIAL); AEROSOLS; PARTICULATES ; POLLUTANTS; BODIES OF WATER; TOPOGRAPHIC LOCATIONS; ATMOSPHERIC PHENOMENA; TURBIDIMETRY; PARTICLE INVESTIGATION METHODS; SOLAR RADIATION; CHEMICAL AND PHYSICAL PHENOMENA; LIGHT RADIATION

Category: MEASUREMENT METH

074231

A STUDY OF THE GASEOUS POLLUTANTS IN THE HOUSTON, TEXAS AREA.

Gordon, S. J. and S. A. Meeks

American Inst. of Chemical Engineers, New York, 33p., March 1975. 4 refs. (Presented at the American Institute of Chemical Engineers, National Meeting, 79th and the 8th Petrochemical and Refining Exposition, Houston, Tex., March 16-20, 1975.)

AM INST CHEM ENGRS NATL MEET 79TH 8TH PETROCHEM REFINING EXPO 1975

FLD Method of Support: CONTRACT .

Field data obtained from an 8-week sampling of ambient gaseous pollutants in the Houston, Texas area during June and July of 1974 are reported. Over 100 samples were collected in Tedlar bags and analyzed by flame-ionization gas chromatography and long-path infrared Fourier transform absorption spectroscopy. Concentrations of various hydrocarbons (saturated and unsaturated), vinyl chloride, carbon monoxide, vinyl acetate, and ammonia are given. Hourly averages are given in monthly summaries, and quarterly summaries are compiled to give the high, second high, arithmetic mean, and standard deviation of the hourly averages for the previous 3 mo. Also given are the number and percentage of hours during which the ambient air quality standard is exceeded.

Descriptors: AREA SURVEYS; ADMINISTRATION; AIR QUALITY MEASUREMENT PROGRAMS; PLANS AND PROGRAMS; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; URBAN AREAS; METROPOLITAN AREAS; AIR QUALITY MEASUREMENTS; AMMONIA; AMMONIUM COMPOUNDS; ESTERS; CHLORINATED HYDROCARBONS; HALOGENATED HYDROCARBONS; HYDROCARBONS; CARBON MONOXIDE; OXIDES; CHLORINATED HYDROCARBONS; ESTERS

Identifiers: VINYL CHLORIDE; VINYL ACETATE

Category: AIR QUALITY MEAS

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MONITORING

Radian Corp.,
Summary of the city of Houston 1972 annual report on air pollution control.
Technical Note 100-027-01, Houston Lighting; Power Contract. to
Austin, TX, undated.

Air pollution-source sampling; *Houston, TX-air pollution; Air pollution-particulate emissions-monitoring; Sampling and sample handling; *Texas-air pollution; Texas-electric utilities; Electric power generation-air pollution;

The City of Houston maintains twenty-seven air quality monitoring sites. Two of these sites are equipped for continuous monitoring and 24-hour samples are taken at the other twenty-five sites. Figure 1 is a map of Houston showing the monitoring site locations and the locations of Houston Lighting and Power generating stations. Note that the largest concentration of air sampling sites is along the ship channel and that there are relatively few monitoring points near the power stations.

Leaderer, Brian P., et al.,
"Summary of the New York Summer Aerosol Study (NYSAS)",
Reprint. APCA J. 28(4), (1978).

The ambient particle aerosol is of great interest due to its suspected role in producing adverse health effects and its known effects on visibility degradation and weather modification. A detailed knowledge of the chemical and physical nature of the urban aerosol, and the relative contribution by different sources is needed before effective control measures can be established. Intensive studies examining the nature and sources of urban aerosols have been conducted in Los Angeles (ACHEX)[1] and St. Louis (RAPS).[2] The results of these two studies, however, may not be applicable to the New York metropolitan area because of several factors discussed by Kneip, *et al.*[3] Recognizing the need for the information that such a study would produce and mutally shared research interests led participants from seven organizations to develop a collaborative study of the New York metropolitan aerosol.

844580
SUSPENDED PARTICULATE HAZARDS TO HUMAN HEALTH IN HOUSTON, TEXAS.
Severs, Richard Keith
Texas Univ., Houston School of Public Health, Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., 1971, 159p. 65 refs.
1971
THEO FLD BIB Method of Support: NONE

The suspended particulate hazards to human health in Houston, Texas were assessed after a study of data related to the following aspects of suspended particulates: a time series, probability of occurrence at hazardous concentrations, metals constituent, and reported hazardous conditions. Metal urban concentrations of copper, zinc, lead, manganese, magnesium, cadmium, chromium, aluminum, cobalt, nickel, vanadium, potassium, calcium, and sodium were measured. Maps were utilized to display the geographic distribution of factors of interest. A time-series study of data gathered by the National Air Surveillance Network was conducted, and trend lines were calculated by four methods. A five year running mean, semi-average, linear regression, and polynomial regression methods all revealed a decline in suspended particulate concentration during 1953-1968. Criteria were developed for comparison of the geographic distribution of suspended particulates in different years. The comparative studies employed probability statistics based on a logarithmical normal transformation of the data. The study of geographic distributions of the several metallic components of suspended particulates was based on several hundred analytical determinations of the metals by means of atomic absorption spectroscopy. Suspended particulates, sulfur oxides, and cadmium were found in some areas of Houston in concentrations which have been associated with morbidity and mortality in other cities. (Author abstract modified)

Descriptors: AREA SURVEYS: ADMINISTRATION: AIR QUALITY MEASUREMENT PROGRAMS; PLANS AND PROGRAMS: NATIONAL AIR SAMPLING NETWORK (NASN): CRITERIA: HOUSTON: AMERICA: NORTH AMERICA; TEXAS: UNITED STATES: SUSPENDED PARTICULATES: PARTICULATES: POLLUTANTS: AIR QUALITY MEASUREMENTS: SPECTROPHOTOMETRY; ANALYTICAL METHODS: TRACE ANALYSIS: MAPPING ; STATISTICAL ANALYSES: METAL COMPOUNDS: ALUMINUM COMPOUNDS: CADMIUM COMPOUNDS; CALCIUM COMPOUNDS: CHROMIUM COMPOUNDS: MAGNESIUM COMPOUNDS; COBALT COMPOUNDS: LEAD COMPOUNDS; NICKEL COMPOUNDS: POTASSIUM COMPOUNDS: SODIUM COMPOUNDS; VANADIUM COMPOUNDS; ZINC COMPOUNDS: SULFUR OXIDES: OXIDES
Category: AIR QUALITY MEAS

Liu, Benjamin Y.H., ed.,
Symposium on fine particles. Aerosol generation, measurement, samplin
and analysis.
Proceedings of an EPA Symposium, Minneapolis, May 1975.
N.Y., Academic, 1976.

Fine particulate collection; Air pollution-particulate emissions-analysis; *Aerosols-analysis; Aerosols-formation; Aerosols-collection; Proceedings;

This volume contains the technical papers presented at the Symposium on Fine Particles held in Minneapolis, Minnesota, May 28-30, 1975. In addition, several papers that were not presented at the symposium, due to the lack of time, are also included.

The purpose of the symposium was to review the state of art and recent developments in instrumentation and experimental techniques for aerosols studies. The focus was on fine particles below about 3.5 μm in diameter. The topics covered include aerosol generation, measurement, sampling, and analysis.

The importance of fine particles to air pollution control is well known: Many of the undesirable effects of particulate air pollutants, such as those on human health and atmospheric visibility, are due to fine particles. However, the control of fine particles is considerably more difficult than the control of coarse particles. In industrial hygiene, mining safety, fire detection, and other related areas, fine particles have also been found to play an important role.

In a rapidly growing field of science where there is a diversity of workers, there is a need for a periodic review of the subject and a convenient source of reference. It is hoped that this symposium volume will help in part to meet that need.

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Texas Air Control Board,
Texas air sampling network, annual surveillance reports for 1971 and 1972, 1976 and 1977. Austin, TX.

Harper, David and Bryan Lambeth,
Trajectory analysis.
DCN 78-200-242-01, HAOS Contract.
Austin, TX, Radian Corp., March 1978.

*Trajectories; Houston, Texas-air pollution; Ozone-analysis; Air pollution monitoring;

The Houston Area Oxidants Study (HAOS) sponsored airbone measurement of ozone and other pollutants in 1976 and 1977. To support the interpretation of the data obtained, air parcel trajectory analyses were performed for HAOS by the Radian Corporation. This Technical Note describes the method of analysis and documents the cases studied. Working documents showing additional details are contained in the project files at Radian.

Texas, State of, Air Control Board,
Urban visibility assessment (UVA).
Austin, TX, Aug. 1976.

Visibility; Air pollution-monitoring; Air pollution-regional; Houston, Texas-air pollution;

The Urban Visibility Assessment project was designed to fill in one of the gaps in data collection by the Texas Air Control Board. As an example of these gaps in coverage, up to this time estimates of visibility for the Houston area have been furnished only by weather observers at the Hobby and Houston Intercontinental airports, augmented by readings from the integrating nephelometers at our Aldine and Mae Drive continuous monitoring stations. The geographical separation of the visual observation sites and the extremely short optical distance over which the integrating nephelometer examines a small sample of air leave wide areas in Houston for which the range of visibility is in some doubt.

035911
USE OF STATISTICAL TECHNIQUES TO ASSESS PROGRESS TOWARD A CLEAN AIR ENVIRONMENT: HOUSTON, TEXAS.
Severs, R. K.
Atmos. Environ., 5(10):853-861, Oct. 1971. 9 refs.
ATMOS ENVIRON 1971
THEO Method of Support: NONE

Computer trend-surface mapping techniques in conjunction with a statistical evaluation of suspended particulate data from Houston, Texas for 1968-1969 are examined as a basic method for evaluation of progress toward a clean air environment. Assessment was accomplished via comparison of current levels of pollution with those previously experienced, a determination of the changes in levels of pollution experienced through representative parts of the geographic area under consideration, and a comparison of the current pollution levels in terms of occurrence with those of stated desirable levels, e.g., ambient air quality goals. (Author abstract modified)

Descriptors: AIR QUALITY STANDARDS; STANDARDS; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; URBAN AREAS; METROPOLITAN AREAS; SUSPENDED PARTICULATES; PARTICULATES; POLLUTANTS; AIR QUALITY MEASUREMENTS; MEASUREMENT METHODS; COMPUTERS; DATA HANDLING SYSTEMS; COMPUTER PROGRAMS; DATA ANALYSIS; MAPPING; STATISTICAL ANALYSES; TOPOGRAPHIC INTERACTIONS; ATMOSPHERIC PHENOMENA
Category: MEASUREMENT METH

022485
USE OF VEGETATION TO MEASURE AIR POLLUTION.
McKee, Herbert C.
Preprint, Inst. Mexicano de Ingenieros Quimicos, 10p., 1961. (Presented at the Instituto Mexicano de Ingenieros Quimicos, Annual Technical Meeting, Mexico City, Mexico, Oct. 19-21, 1961.)
INST MEXICANO DE INGENIEROS QUIMICOS 1961
TECH Method of Support: NONE

The sequence of procedure in the conduct of an air pollution survey based on plant damage is delineated. The first step is field inspection of all vegetation in the area by a trained plant scientist to determine damage caused by pollution vs. damage from other factors, and possibly to locate sources of local pollution. Samples are then collected and analyzed, by prescribed methods to identify the atmospheric pollutants that have caused the damage. The importance of having control samples is stressed. An example of the use of vegetation techniques in an air pollution survey is given for Houston, Tex. The area was divided into sectors and samples obtained for analyses from each section throughout the year; these values were then used in computing a pollution index based on vegetation damage. Native elm and the Arizona ash were studied as indicators of sulfur dioxide pollution. Vegetation symptoms could be used readily to obtain information on general pollution conditions in the Houston area, and that despite the limitations of the method, the pollution indexes thus derived provided data which could only be obtained at great expense using atmospheric analysis techniques. A table is included on the use of plants in determining pollution, via visible damage and chemical analysis. for 10 general types of phytotoxic air pollutants.

Descriptors: AREA SURVEYS; ADMINISTRATION; AIR QUALITY MEASUREMENT PROGRAMS; PLANS AND PROGRAMS; SURVEY METHODS; PLANT DAMAGE; PLANT INDICATORS; SMOG; PARTICULATES; POLLUTANTS ; SUSPENDED PARTICULATES; PHYTOTOXICANTS; SULFUR DIOXIDE; OXIDES; SULFUR OXIDES

Category: EFFECTS-PLANTS, LIVEST

017784

VEGETATION SYMPTOMS AS A MEASURE OF AIR POLLUTION.

McKee, Herbert C. and Frederick W. Bieberdorf

J. Air Pollution Control Assoc., 10(3):222-225, June 1960. 7 refs. (Presented at the Air Pollution Control Association 52nd Annual Meeting, Los Angeles, Calif., June 21-26, 1959.)

J AIR POLLUTION CONTROL ASSOC 1960

FLD Method of Support: NONE

A study was made of the use of ash and elm trees as indicators of relative pollution levels. Sulfate content of vegetation samples can be used to obtain a semi-quantitative measure of long-term exposure to sulfur dioxide. To the extent that SO2 is also related to over-all pollution levels, this can be used as general indicator of pollution. In the study made in the Houston area, these data were used to calculate pollution indexes in different areas of Harris County, in order to determine relative pollution loadings. These data provide the best means of making such comparisons, and are much better than data obtained with a mobile laboratory. Permanent sampling stations might offer a means of obtaining more accurate results if a sufficient number of stations could be operated, but for a survey in which only limited financial resources are available, this method offers the best possibility where applicable. The comparative ease and economy of obtaining data are major advantages. The results represent the cumulative effects of continuous exposure over a known period of time, with a continuity which can only be approached with continuous recording equipment subject to interruptions by breakdown, power failure, etc. The major disadvantage is the fact that cumulative results give no indication of short time peak values that occur during the sampling period. (Author conclusions modified)

Descriptors: TREES; PLANTS (BOTANY); PLANT INDICATORS; CONTINUOUS MONITORING; MEASUREMENT METHODS; MONITORING; SULFUR DIOXIDE; OXIDES; SULFUR OXIDES

Category: EFFECTS-PLANTS, LIVEST

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AN  - PB-269 592/2SL
TI  - Air Pollution Meteorology During the Houston Urban Plume Study.
      July 1974
TNO - Final rept. 1 Jul 74-1 Jul 75
AU  - Hoffnagle. Gale F.
OS  - INTERA Environmental Consultants Ltd.. Houston.
      Tex.*Ervironmental Sciences Research Lab.. Research Triangle
      Park. N.C.
PD  - Jul 77: 66p
IS  - U772:
PR  - NTIS Prices: PC A04/MF A01
    - EPA/600/3-77/073
CC  - 13B: 4B: 68A: 55C
IT  - *Air pollution: *Meteorological data: *Urban areas: Wind
      velocity: Atmospheric sounding: Temperature inversions:
      Fronts(Meteorology): Meteorological balloons: Radiosondes: Upper
      atmosphere: Tables(Data): Texas
ST  - Houstor(Texas): NTISEPAORD
AB  - Meteorological parameters were measured during an EPA sponsored
      air sampling program from 15-24 July. 1974. in Houston. Texas.
      The data collected are primarily surface anemometer data and
      pilot-balloon soundings to 1830 meters above ground. These
      measured data. along wrth plots from the National Weather
      Service. were used to provide an overall meteorological analysis
      of conditions during the sampling program. Because the air
      samplirg was performed primarily from a fixed-wind aircraft.
      emphasis was given to the ambient environment aloft.
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Griffiths, J.F., R.C. Runnels, and C.L. Norton,
<u>Air stagnation advisory evaluation for Texas</u>.
Project E/S-4A
*Air pollution-meteorological factors;
Texas-air pollution;

The Texas Air Control Board (TACB) was awarded a contract from the Governor's Energy Advisory Council under the Environmental and Social (E/S) program. The contract (E/S4) is to evaluate the potential for selective standards of pollution control based on an analysis of meteorological conditions in Texas. The TACB awarded the Texas A&M University Meteorology Department a contract to carry out an Air Stagnation Advisory evaluation (sub-project of project E/S4). A nine point work plan and program was also submitted as a guideline for the progress of the subproject E/S4.

The purpose of the Air Stagnation Advisory evaluation will be to assess thoroughly the National Weather Service model as it applies to Texas.

16.1-270 551.551.8(764) :551.511.6

•Waldron, Albert W., Jr. (*Dugway Proving Ground, Utah*), **Application of an elevated line source diffusion formula.** *Journal of Applied Meteorology*, Boston, 2(6) :740-746, Dec. 1963. 8 figs., 5 tables, 2 refs. **DWB, DLC**—A series of nighttime elevated line source diffusion trials conducted in Texas during 1961 is used to evaluate the adequacy of a current diffusion equation model and to define the turbulent layer within which such a model can be applied with any degree of success. The turbulent layer is defined in terms of Richardson number and the vertical intensity of turbulence. *Subject Headings:* **1. Diffusion formulas 2. Line source diffusion 3. Texas, United States.**—*Auth.*

Texas Air Control Board,
Attainment analysis, vol. 1, Causes of non-attainment.
Austin, TX, Jan. 1977.

Air quality-data; *Texas-air pollution; Texas-air pollution-meteorological factors; Texas-air pollution-monitoring; *Texas-air pollution-particulate emissions; Texas-air pollution-standards and criteria; Texas-air pollution-implementation plants; Texas-air pollution-particulate emissions-control methods; Texas-air pollution-source sampling; Air pollution-fugitive dust;

National ambient air quality standards for suspended particulates were promulgated in the Federal Register on April 30, 1971. The Texas State Implementation Plan includes a particulate control strategy designed to attain the primary standards by May 31, 1975. The control strategy for particulates was approved on May 31, 1972 by the U. S. Environmental Protection Agency (EPA). Sufficient data are now available to determine whether or not the particulate standards have been attained in Texas as planned. Where the standards have not been attained, the Implementation Plan needs to be examined to determine what revisions, if any, are necessary to achieve the standards. This report is part of the current effort to examine the Texas Implementation Plan to decide what revision of the particulate control strategy is necessary. Although there are also secondary particulate standards, this report considers only the primary standards, which are set to protect public health. The standards are 1) a 24-hour average of 260 micrograms per cubic meter (ug/m^3) not to be exceeded more than once a year and 2) an annual geometric mean of 75 micrograms per cubic meter, not to be exceeded.

Texas Air Control Board,
Attainment Status of the Total Suspended Particulate Air Quality Standards in the Houston/Galveston and Dallas/Fort Worth Areas.
Austin, Texas, May 1976.

*Texas-air pollution; Air pollution-particulate emissions-standards and criteria; Air pollution-implementation plans;

National Ambient Air Quality Standards for suspended particulates were promulgated by federal regulations on April 30, 1971. The Texas State Implementation Plan, designed in part to attain these standards by May 31, 1975, was approved with exceptions on May 31, 1972 by the Environmental Protection Agency (EPA). Sufficient data are now available to determine if the particulate standards have been attained in Texas as planned. If the standards have not been attained, then the Implementation Plan should be examined to determine if revisions are necessary to achieve the standards. This report is part of an effort to so examine the Texas Implementation Plan.

100872
Chemical and Meteorological Analysis of the Mesoscale Variability of Ozone Concentrations over a Six-Day Period
Bach, W. D., Jr.; Sickles, J. E., II; Denyszyn, R.; Eaton, W. C.
Environmental Protection Agency, Research Triangle Park, N. C., Environmental Sciences Research Lab.
Int. Photochem. Oxidant Pollut. Control Conf. Proc., Vol. I, Raleigh, N. C., 1976 pp. 197-210 1977
Note: (Sept. 12.) (Rept. EPA-600/3-77-001a.)
Doc Type: U; Original (Field)
CAS Registry No: 10028-15-6

The Research Triangle Institute conducted low altitude aircraft flights over east Texas, most of Louisiana, and adjacent areas of the Gulf of Mexico to investigate the areal extent of high ozone concentrations. Ozone concentrations were continuously measured along the flight paths and at ground stations at Corpus Christi Port O Connor, Austin, Houston, and Port Arthur, Texas and at DeRidder, Louisiana. On October 19, 1975, a high pressure system developed over the area and subsiding motion began to develop a stable layer of air aloft. Ozone concentrations in excess of 160 microgram/cu m were found over east Texas and over western Louisiana. As the pressure system developed and moved eastward the next day, the highest ozone was measured over Louisiana. Ozone concentrations remained above 160 microgram/cu m at 300 over the Gulf of Mexico and inland, but decreased to 100 microgram/cu m above the stable layer. Ozone measurements at the ground monitoring locations agreed with the trends of the airborne measurements. Time-altitude cross sections of potential temperature at Lake Charles, Louisiana, showed a dynamic atmospheric boundary layer. Ozone precursor emissions in the study area and limited ventilation are primarily responsible for maintaining the high ozone concentrations until cleaner air is transported into the region. (Author abstract modified) (9 Refs)

Descriptors: Pollutants; Pollutant Precursors; Oxidant Precursors; America; North America; United States; Louisiana; Texas; Airports; Sources; Mobile Emission Sources; Transportation Methods; Aircraft; Atmospheric Phenomena; Altitude; Ground Level; Lower Atmosphere; Ozone; Air Quality Measurements

Category: Pollution Data; Pollution Data (Air Quality Measurements)

16.3–12 551.582.1(263)(764)

*†Orton, Robert B. (*Weather Bureau State Climatologist, Austin, Tex.*). **Climate of Texas and the adjacent Gulf waters.** Wash., D. C., U. S. Weather Bureau, 1964. 195 p. Numerous figs., tables, 11 + 60 refs. Price: $1.00 from U. S. Govt. Print. Off. **DWB** (M82.2/764 U587cL) Provides meteorological information and data necessary for the testing of certain spaceflight apparatus and for the selection of possible spacecraft landing sites. Emphasis is placed on presentation and analysis of data pertaining to sky cover, ceiling height, visibility, and wind; to the local physiography; and the synoptic weather systems that influence or control these factors. South Texas, adjacent Gulf waters, and north Texas are treated separately. The length of data records vary from 6 to 18 yrs, except Hondo AAF which has only 3 yrs data. Information on severe storms, turbulence inversion, sea and land breezes, air pollution and dust devils is included. Forecasting rules of thumb are also given. *Subject Headings:* **1. Climate of Texas 2. Climate of Texas coastal waters 3. Climate of western Gulf of Mexico 4. Texas, United States 5. Gulf of Mexico.**—*E.Z.S.*

CLIMATOLOGICAL ASSESSMENT OF URBAN EFFECTS ON PRECIPITATION. (FINAL REPORT). PART II. DESCRIPTION OF INDIVIDUAL URBAN STUDIES.

Huff, F. A. and S. A. Changnon, Jr.

Illinois State Water Survey, Urbana, National Science Foundation Grant GA-18781, 241p., May 1972. 55 refs.

1972

FLD BIB Method of Support: NONE

Urban effects on precipitation at St. Louis, Chicago, Indianapolis, Cleveland, Washington, D. C., Houston, New Orleans, and Tulsa were investigated. The relationship of thunder and hail increases to urban size and pollution factors was studied; the hydrologic implications of inadvertent weather modifications were also studied. Data on the individual urban studies are presented, including analytical procedures, data analysis techniques, spatial and time charts of rainfall patterns, diurnal, monthly, and seasonal variations, topographic interaction parameters, particulate and thermal emission data, and meteorological functions.

Descriptors: DIURNAL; MONTHLY; SEASONAL; CHICAGO; AMERICA; ILLINOIS; NORTH AMERICA; UNITED STATES; INDIANA; NEW ORLEANS; LOUISIANA; ST LOUIS; MISSOURI; OHIO; OKLAHOMA; HOUSTON; TEXAS; WASHINGTON D C; URBAN AREAS; METROPOLITAN AREAS; PARTICULATES; POLLUTANTS; AIR QUALITY MEASUREMENTS; ANALYTICAL METHODS; DATA ANALYSIS; DATA HANDLING SYSTEMS; MAPPING; METEOROLOGY; ATMOSPHERIC PHENOMENA; MICROMETEOROLOGY; PRECIPITATION; RAIN; THUNDERSTORMS; WEATHER MODIFICATION; TOPOGRAPHIC INTERACTIONS; PARTICLE GROWTH; CHEMICAL AND PHYSICAL PHENOMENA; THERMAL RADIATION; INDIANA; OHIO; OKLAHOMA

Identifiers: INDIANAPOLIS; CLEVELAND; TULSA

Category: ATMOS INTERACT

022339

A COMPARISON OF THE SPECTRAL DISTRIBUTION OF SOLAR RADIATION IN A POLLUTED AND A CLEAN AIR MASS.

Randerson, Darryl

J. Air Pollution Control Assoc., 20(8):546-547, Aug. 1970. 9 refs.

J AIR POLLUTION ASSOC 1970

FLD Method of Support: NONE

Two spectroradiometer measurements are presented to illustrate differences in the spectrum of sunlight in the 0.45-0.7 micron band. Measurements were taken on a November day at about 1800 GMT, west of polluted downtown Houston, and at another site located approximately 15 miles NW in apparently pollution-free air. A 23-24% loss in the 0.45-0.7 micron band is attributed to attentuation by airborne particulates in the polluted air mass. The loss is wavelength dependent, with the short wavelengths being scattered more than the long wavelengths. Absorption by ozone was probably occurring in the Chappuis bands, between 0.45 and 0.65 micron; however, 03 absorption in these bands is weak. Large quantities of hydrocarbons emitted by oil refineries in the Houston-Galveston area are noted to combine with rush-hour automotive exhaust emissions to create a potential for 03 formation when the sunlight is intense enough for rapid photochemical reactions. Consequently, some of the loss in radiant energy may be due to absorption through photochemical losses in the polluted air mass. When light depletion persists for two or three days, a physiological response probably occurs in plants and animals.

Descriptors: HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; URBAN AREAS; METROPOLITAN AREAS; FUEL OILS; FUELS; SOURCES; STATIONARY EMISSION SOURCES; INDUSTRIAL EMISSION SOURCES; SPECTROMETRY; ANALYTICAL METHODS; HYDROCARBONS; OZONE ; PHOTOCHEMICAL REACTIONS; CHEMICAL AND PHYSICAL PHENOMENA; CHEMICAL REACTIONS; SOLAR RADIATION; LIGHT RADIATION; LIGHT SCATTERING

Category: ATMOS INTERACT; AIR QUALITY MEAS

100878

Development of a Markov Chain Model for Photochemical Oxidant Prediction

Martinez, J. R.

Environmental Protection Agency, Research Triangle Park, N. C., Environmental Sciences Research Lab.

Int. Photochem. Oxidant Pollut. Control Conf. Proc., Vol. II, Raleigh, N. C., 1976 pp. 827-835 1977

Note: (Sept. 12.) (Rept. EPA-600/3-77-001b.)

Doc Type: U; Original (Theoretical)

A method is described whereby the time series of hourly photochemical oxidant is modeled by a Markov chain. The model s output is the probability of exceeding 0.08 ppm during a year in a given geographical region. The forecast of such statistical data complements results of other models which predict absolute concentration levels. The Markovian structure of the time series is tested using data for Houston, Texas. The output of the Markov model is related to the statistical criterion imposed by the National Ambient Air Quality Standard for photochemical oxidants. A technique to estimate the parameters of the Markov chain is briefly discussed. (7 Refs)

Descriptors: Standards; Air Quality Standards; Mathematical Analyses; Mathematical Modeling; Pollutants; Oxidants; America ; North America; United States; Texas; Houston; Atmospheric Phenomena; Air Pollution Forecasting

Category: Atmospheric Interaction; Atmospheric Interaction (Chemical and Physical)

ID No. - MGA22030415

Diurnal variation of kinetic and internal energy in onshore winds along the upper Texas Gulf Coast

Yu, Tsann Wang,

Texas, Univ., Austin. College of Engineering. Atmospheric Science Group. Report No. 19, Jan. 1970. 42 p. Refs. DAS

DESCRIPTORS: Sea breeze energetics; Texas. United States

Mahrer, Ytzhaq and Roger A. Pielke,

"The effects of topography on sea and land breezes in a two-dimensional numerical model",

Month. Weather Rev. 105, 1151 (1977).

A mathematical two-dimensional hydrostatic model has been employed for the study of mesoscale circulations which develop over a mountain barrier, a flat coastline and a mountainous coastline when the prevailing flow is zero. One of the main features of the model is the inclusion of the parameterization of the surface heat budget, and shortwave and longwave radiative fluxes. Results show that the combined sea breeze and mountain circulations produce a more intense circulation during both day and night than when they act separately. The mountainous coastline case generates an inland penetrating sea breeze which develops a leeside cell of upward vertical velocity. The predictions are in qualitative agreement with the observed phenomenon.

Schmidt, F.H.,
"An elementary theory of the land- and sea-breeze circulation",
J. Meteor. 4, 9-15 (1947).

As physically more or less exact theories of the land and sea breezes lead to results that are not correct in every respect, an attempt is made here to find an elementary solution for the problem. The solution is called an elementary one because the mutual influence of temperature distribution and velocity is not taken into account. A rather simple temperature distribution is adopted a priori, and the velocity distribution is calculated from it. In section 3 account is taken of the deflecting force of the earth's rotation; the result is found that in temperate latitudes the sea breeze when at full strength does not blow perpendicular to the coast.

12L-319 **551.509.318:681.177**

†Franceschini, Guy A., **Forecasting micrometeorological variables.** Texas A. & M. College. Dept. of Oceanography and Meteorology, Contract AF 19(604)-2250, Final Report, Dec. 1959. 65 p. 20 figs., 21 tables, 4 refs. DWB—An objective evaluation was conducted on the utility of a specialized analogue computer for micrometeorology. Values of parameters simulated by the computer are compared with values observed. Parameters of concern were: air temperature at a height equal to the roughness parameter (z_0); air temperature at 2 m; temperature difference between ½ m and 4 m; wind speed at 2 m; vapor pressure at 2 m; and relative humidity at 2 m. Results are shown in graphs of simulated and observed values as a function of time, and tables of statistical parameters of the verification. Comparisons were made for five different periods invol ing four locations. The locations, all in Texas, represented appreciably different surfa Meteorological conditions were varied and included the following air mass types: arctic, mariti polar, continental polar and maritime tropical. A brief description of each site with a summa of its attendant meteorological conditions is given. Although appreciable difficulty was expe enced in keeping the computer in operation, in general the simulated results were good. Ho ever, the computer tends to minimize the diurnal amplitude of the variables. Weakest areas the computer were: temperature lapse rate when strong stability was observed; vapor press when high values existed; and wind speed generally. Suggestions for future work are give *Subject Headings:* 1. Micrometeorological variables 2. Analog computers 3. Texas-*Author's abstract.*

Anthes, Richard A.,
"The height of the planetary boundary layer and the production of circulation in a sea breeze model",
J. Atmos. Sci. 35(7), 1231 (1978).

A two-dimensional mesoscale model is applied to study the evolution of a strong sea breeze on a stagnant base state. In contrast to previous studies, this paper considers the relationship of the planetary boundary layer (PBL), the thermodynamic structure and the vertical circulation associated with the sea breeze in detail.

The development of the sea breeze circulation is studied quantitatively using the circulation theorem. The circulation in the vertical plane normal to the coast develops as a result of the solenoid term. The vertical diffusion of momentum acts as the most important brake on the developing circulation in agreement with previous theoretical results. The Coriolis term is small until 6 h after the heating cycle. Late in the cycle, however, it reaches a value of 45% that of the solenoid term. Horizontal and vertical advective effects are small.

Under zero geostrophic wind conditions, the return flow occurs entirely above the PBL. Therefore, neutrally buoyant pollutants emitted at the surface can only enter the return flow through the narrow zone of upward motion at the sea breeze front. Trajectories indicate that considerable recirculation toward the shore of these pollutants as well as pollutants left over in the previous day's mixed layer may occur. For the time and space scale of the sea breeze considered here, Coriolis forces are important in causing significant transports along the coast.

The depth of the circulation and the trajectories are sensitive to the rate of heating over land and the initial static stability. For strong heating in a relatively unstable environment, a significant component to the return circulation exists up to 5 km. For moderate heating in a more stable environment, there is very little return circulation above 3 km.

Radian Corp.,
Houston Lighting and Power Company ambient air impact parametric stud
2 vols.
Technical Note 100-027-04, Houston Lighting & Power Contract
Austin, TX, Aug. 1974.

Texas-electric utilities; Texas-air pollution; *Houston, TX-air pollution
SO_2-air pollution; Air pollution-particulate emissions; Air pollution-meteorological factors; NO_x-air pollution; Fuel oil-use; Atmospheric dispersion; Plumes-mathematical models; Computer models; Electric power generation-air pollution;

This report documents a parametric study Radian performed to determine the ambient air quality impact of various electrical generating stations in the Houston Lighting and Power Company system. The purpose of this study was to provide HL&P with data concerning various conceivable alternate expansion/conversion plans. Radian's task was to estimate through computer simulation the potential ambient air impact in the vicinity of the stations under consideration. Those stations were Cedar Bayou, Deepwater, Greens Bayou, W. A. Parish, P. H. Robinson, Sam Bertron, Webster, and T. H. Wharton. Each station was considered individually. The main criteria tested in this study were 30-minute average SO_2 concentrations as predicted by Radian's plume dispersion model. Annual averages for SO_2, particulates, and NO_x were also estimated for many of the cases modeled. The primary fuel considered was fuel oil.

ID NO.- MCA21030458
Hurricane surge frequency estimated for the Gulf Coast of Texas.
Bodine, B. R.
U. S. Coastal Engineering Research Center, Wash., D. C., technical Memorandum No. 26, Feb. 1969, 32 p. Figs., tables, refs., eqs.
DESCRIPTORS: Hurricane surge; Gulf of Mexico.-Auth.

051043
INADVERTENT PRECIPITATION MODIFICATION BY MAJOR URBAN AREAS.
Huff, F. A. and S. A. Changnon, Jr.
Preprint, American Meteorological Society, Boston, Mass., p. 73-78, 1972. 4 refs. (Presented at the Conference on Weather Modification, 3rd, Rapid City, S. Dak., June 26-29, 1972.)
CONF WEATHER MOD 3RD RAPID CITY S DAK 1972 1972
FLD Method of Support: NONE

Urban effects on precipitation in and around major U. S. cities, including St. Louis, Chicago, Cleveland, Indianapolis, Washington, D. C., Houston, New Orleans, and Tulsa, were analyzed. Daily and seasonal precipitation distributions, frequency of heavy rainstorms, and hail- and thunder-day occurrences were tabulated. In general, relatively strong evidence of urban effects was determined in the daily and/or seasonal precipitation distributions for St. Louis, Chicago, Cleveland, and Washington, D. C. Evidence was weak or nonexistant at Indianapolis, Urbana, Tulsa, and New Orleans. Urban effects in Houston could be identified only in May-September rainfall of air mass origin. The urban effect was more pronounced in the summer than in winter and was usually maximized 10-35 mi downwind of the central city. Effects within the cities were identified at Chicago, Washington, D. C., Houston, and New Orleans. Thunder- and hail-day frequency increases were established in the six largest cities and were greatest in the warm season, generally the summer.

Descriptors: DIURNAL; SEASONAL; CHICAGO; AMERICA; ILLINOIS; NORTH AMERICA; UNITED STATES; NEW ORLEANS; LOUISIANA; ST LOUIS ; MISSOURI; OKLAHOMA; HOUSTON; TEXAS; WASHINGTON D C; URBAN AREAS; METROPOLITAN AREAS; PRECIPITATION; ATMOSPHERIC PHENOMENA; METEOROLOGY; RAIN; THUNDERSTORMS; WEATHER MODIFICATION; TOPOGRAPHIC INTERACTIONS; INDIANA; OHIO; OKLAHOMA; PRECIPITATION

Identifiers: INDIANAPOLIS; CLEVELAND; TULSA; HAIL

Category: ATMOS INTERACT

19.5-245 551.553.11(261.64)(764):551.501

Instrumenting the Sea Breeze Project. *Facilities for Atmospheric Research*, Boulder, Colo. No. 4:2-5, Summer, 1967. Figs., photo. **DAS, DLC**—The scope and aims of the Sea Breeze Project which involves an investigation of the mechanisms of the sea breezes along the Texas Gulf coast are described. The project seeks to verify experimentally Estoque's 2-dimensional model and to extend it to 3 dimensions. The topography of the study area and the observational network are described. The 1967 program is outlined. The use of scale analysis for determining the proper use of each instrument and the energy exchanges are discussed. *Subject Headings:* **1. Sea breeze studies 2. Sea breeze models 3. Gulf of Mexico 4. Texas, United States.**—*I.L.D.*

Wolff, George T., et al.,
"An investigation of long-range transport of ozone across the midwestern and eastern United States",
Atmos. Env. 11, 797-802 (1977).

Abstract—Long-range transport of ozone across the midwestern and eastern U.S. was investigated by analyzing daily ozone isopleth maps and comparing them to meteorological maps and air parcel trajectories for the period April 12-23, 1976. This period was characterized by the presence of a large high pressure system which produced widespread ozone concentrations of greater than 0.08 ppm as well as record-breaking maximum springtime temperatures over much of the study area. Daily maximum ozone values from the state networks were used to produce the daily ozone maps. Movement of areas of high ozone concentrations corresponded to the movement of the high pressure system. Actual transport across these areas is supported by trajectory analysis. Daily visibility maps were also prepared and they suggest that areas of low visibility generally coincide with areas of elevated ozone under certain conditions.

17.6-13 **551.577.2(764):551.577.3:519.2**

Tucker, Joseph E., Investigation of the precipitation distribution and probability of receiving selected amounts over Texas. May **1965.** Thesis (M.Sc.)—Texas A&M Univ. **113** p. Numerous figs., tables, refs. **DWB** (M77.2 T892in)—The distributions of monthly and annual precipitation amounts for 34 selected Texas stations have been investigated in an effort to determine the fit of monthly values to a square-root normal distribution and that of annual amounts to a normal distribution. Forty years of data from each of the 34 stations were processed statistically using the IBM 7090/7094 Programming System. A series of significance tests has been used to determine if the assumption of the respective normal distributions is justified. These tests show that 88% of the monthly data and 71% of the annual data are not significantly different from normal. From data which were determined to fit the individual normal distributions, maps of the annual mean and standard deviation and maps of the monthly square-root mean and standard deviation have been prepared. These maps were used to interpolate for additional values of the two statistical parameters. These parameters, in conjunction with tables of the normal distribution, were then used to obtain probabilities of a real observation exceeding selected amounts of precipitation and to calculate the amounts of precipitation associated with a selected probability. A series of maps of isolines of probability for selected monthly and annual precipitation amounts and a map of contours of precipitation have been introduced to characterize the regional and annual patterns of precipitation and to demonstrate the realistic advantages of the study. *Subject Headings:* 1. Precipitation distribution 2. Precipitation probabilities 3. Statistical analysis of precipitation 4. Texas, United States.—*Auth.*

100859
A J Relationship for Texas
Walker, H. M.
Environmental Protection Agency, Research Triangle Park, N. C., Environmental Sciences Research Lab.
Int. Photochem. Oxidant Pollut. Control Conf. Proc., Vol. II, Raleigh, N. C., 1976 pp. 851-869 1977
Note: (Sept. 12.) (Rept. EPA-600/3-77-001b.)
Doc Type: U; Original (Theoretical)

CAS Registry No: 10028-15-6
An upper limit curve relationship has been contracted for more than 900 ozone-non-methane hydrocarbon data pairs obtained by the Texas Air Control Board monitoring network since 1973. Unlike the AP-84 curve, the Texas Air Control Board curve interests the .0 6-9 am non-methane hydrocarbon axis at .125 ppm ozone. It also reaches a maximum at 1.1 ppm 6-9 am non-methane hydrocarbon, and then descends to values below the National Ambient Air Standard for ozone at levels above 5.0 ppm non-methane hydrocarbon. Fifty-nine data pairs from the Houston Air Pollution Control District network move the maximum out to 2.4 ppm, but do not change the shape of the curve. The possible implications of the Texas J curve are discussed. (Author abstract) (9 Refs)
Descriptors: America; North America; United States; Texas; Houston; Hydrocarbons; Ozone; Air Quality Measurements; Non-Methane Hydrocarbons
Category: Atmospheric Interaction; Atmospheric Interaction (Chemical and Physical)

Radian Corporation,
M-1 Meteorological Data Needs and Characterization, draft report.
DCN 77-100-144-02 , Radian Project No. 100-144.
Austin, Tx, Jan. 1977.

*Houston, Texas-air pollution; Photochemical pollutants;

The purpose of this investigation is to determine and recommend the additional meteorological monitoring and models needed to characterize three-dimensional air movement, oxidants, and haze in the Houston area. The project is divided into three tasks:

- Task I: The Location, Documentation, and Display of Continuous Meteorological Monitoring Stations in the Houston District.
- Task II: The Determination of Data Needs and Methods for Characterizing Air Movement Below the 500-Millibar (13,000 - 20,000 Feet) Level.
- Task III: Recommendations for Characterizations of Three-Dimensional Air Movement, Oxidants, and Haze in the Houston Area.

Task III incorporates the results of Tasks I and II to derive several alternative plans of monitoring and modeling. The approximate costs of these options are also presented. Experts in the modeling of three-dimensional air movement and photochemistry are also identified for possible use as consultants in future phases of the HAOS.

20.9-205 551.510.42(764)

Orton, Robert. **Meteorological potential for air pollution in Texas.** 1968. 6 p. Figs. tables. Reprinted from *Texas Business Review*, 42(10), Oct. 1968. **DAS** (M10.42 078me) —Assesses the meteorological parameters of air pollution for the state: the role of wind stability of the air (including inversion), precipitation and thunderstorms, and other atmospheric properties important to pollution, such as humidity, cloudiness, and radiation, are discussed. Topographic effects on the transport and diffusion of pollutants in Texas are considered, with special reference to the generally flat terrain, and the significance of the adjacent Gulf of Mexico. The climatology of the state is reviewed, noting the transitory nature of most anticyclones crossing its borders. The air pollution potential is calculated on the basis of a combination of low wind speeds and limited vertical mixing. Estimated mean maximum mixing depths for 22 major localities are tabulated. It is concluded that although stagnation of air masses and the threat of air pollution are more likely to occur over the East Texas Pine Belt than elsewhere, the "restless" climate of the state does not favor objectionable concentration of air pollutants during much of the time. For the whole state, the most serious pollution episodes are likely to occur in Dec. and Jan. *Subject Headings:* **1. Atmospheric pollution potentials 2. Atmospheric pollution meteorology 3. Weather effects on atmospheric pollution 4. Texas, United States.**—*J.P.D.*

BIBLIOGRAPHY (continued)
METEOROLOGY

046514

A NUMERICAL STUDY OF CONVECTIVE TRANSPORT OF A GASEOUS AIR POLLUTANT IN THE VICINITY OF TALL BUILDINGS.

Djuric, D. and J. C. Thomas

New Mexico State Univ., Las Cruces. Proc. Symp. Air Pollut., Turbul. Diffus., Las Cruces, N. Mex., 1971, p. 27-34. 12 refs. (Dec. 7-10.)

PROC SYMP AIR POLLUT TURBUL DIFFUS LAS CRUCES N MEX 1971 1971

THEO LAB Method of Support: NONE

USGRDR No.: NTIS, CONF-711210

With the advent of larger and faster computers it is becoming feasible to solve transport and diffusion equations under more complicated conditions than previously attained. The flow around buildings of various shapes is geometrically complicated, but can be simulated in a three-dimensional model. A numerical model which simulated fluid motion and pollutant diffusion for the region of downtown Houston during 36 minutes of actual time is considered.

Descriptors: FEASIBILITY STUDIES; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; BUILDINGS; STRUCTURES; URBAN AREAS; METROPOLITAN AREAS; COMPUTER PROGRAMS; DATA HANDLING SYSTEMS; SIMULATION; DIFFUSION MODELS; ATMOSPHERIC PHENOMENA; DIFFUSION (ATMOSPHERIC); DISPERSION; DIFFUSION (ATMOSPHERIC); CONVECTION (ATMOSPHERIC); ATMOSPHERIC MOVEMENTS; METEOROLOGY; TOPOGRAPHIC INTERACTIONS; AERODYNAMICS; CHEMICAL AND PHYSICAL PHENOMENA; FLUID FLOW

Category: ATMOS INTERACT

McPherson, Ronald D.,
"A numerical study of the effect of a coastal irregularity on the sea breeze",
J. Appl. Meteor. 9, 767 (1970).

The modification of the sea breeze circulation by irregular coastlines is examined by integrating a three-dimensional nonlinear numerical sea breeze model with a large bay incorporated into the surface boundary conditions. The results show that the presence of a bay produces a landward distortion of the sea breeze convergence zone and that within the zone there develop definite extrema of vertical motion, the positions of which are closely related to the bay. Furthermore, the intensity of convergence and upward motion within the zone are distributed asymmetrically with respect to the bay. This is a result of the Coriolis acceleration and the bay-induced component of the pressure-gradient force acting in concert on one side of the bay and in opposition on the other.

ID NO.- MGA23120315

Observational study of winter temperatures in the urban area of Houston, Texas.

Runnels, R. C.; Randerson, D.; Griffiths, J. F.

Dept. of Met., Texas A&M Univ., College Station

International Journal of Biometeorology, Amsterdam, 16(2):119-129, April 1972.

CTRY OF PUBL:NL

DOC TYPE: j

DESCRIPTORS: Urban temperatures; Houston, Texas

UCD NOT:551.524:551.568.7

Texas Air Control Board,
Particulate attainment analysis, vol. 2, Status of major compliance programs in the Brownsville-Laredo, Corpus Christi, Houston/Galveston, Dallas, San Antonio/Eagle Pass, and El Paso air quality control regions.
Austin, TX, Dec. 1976.

Air pollution-particulate emissions-standards and criteria; *Texas-air pollution; Air pollution-air quality maintenance plans; Air pollution-implementation plans; Houston, Texas-air pollution;

Texas Air Control Board, Standards and Regulations Program, Abatement Requirements and Analysis Division,
Photochemical oxidant attainment analysis, summary and analysis of ozone data.
Austin, TX, July 1977.

*Texas-air pollution; Ozone-standards; Photochemical pollutants-standards; Ozone-monitoring;

As part of the Environmental Protection Agency's (EPA's) requirement for submittal of revisions to the State Implementation Plan (SIP), the Texas Air Control Board (TACB) must examine the available ozone data from nine air quality control regions (AQCRs) within the state.[1] This report provides the base statistical data for photochemical oxidants (measured as ozone) required for the determination of the attainment status of the photochemical oxidant (ozone) standard in each of the nine AQCRs.

057747
PRECIPITATION MODIFICATION BY MAJOR URBAN AREAS.
Huff, F. A. and S. A. Changnon, Jr.
Bull. An. Meteorol. Soc., 54(12):1220-1232, Dec. 1973. 29 refs.
BULL AM METEOROL SOC 1973
FLD BIB Method of Support: NONE
Historical weather records at eight American urban areas of varying type, size, and climate were studied for indications of inadvertent precipitation modification. The cities were St. Louis, Chicago, Indianapolis, Cleveland, Washington, Houston, New Orleans, and Tulsa. The six largest cities all experienced warm seasonal rainfall increases of 9-17% during the 1955-1970 period. The increases in the Midwest cities occurred largely with cold fronts, but in the coastal cities they were largely during air mass (nonfrontal) conditions. The Midwest increases also occurred as enhancement, not initiation, of moderate to heavy rain days. Significant

increases in summer thunder-day frequencies (13-41%) and hail-day frequencies (90-450%) were found at the six largest cities, and the increases occurred largely in the morning hours. The typical locations of maxima in the Midwest cities were thunder over and near the city, and rain and hail 25-55 km downwind. The maxima of all events in coastal cities were in or near the city. Overall, urban precipitation enhancement was related to city size, industrial nuclei generation, and urban thermal effects. The alterations have considerable relevance to urban design, local area forecasting, local water supplies, agricultural production, hydrologic design, and planned weather modification. (Author abstract modified)

Descriptors: DIURNAL; SEASONAL; URBAN AREAS; METROPOLITAN AREAS; ATMOSPHERIC MOVEMENTS; ATMOSPHERIC PHENOMENA; METEOROLOGY; WINDS; PRECIPITATION; RAIN; THUNDERSTORMS; WEATHER MODIFICATION; ATMOSPHERIC MOVEMENTS; PRECIPITATION

Identifiers: FRONTS; HAIL

Category: ATMOS INTERACT

Severs, Richard K.,

Respirable particulate monitoring with remote sensors, public health ecology: air pollution, final report.

NAS 9-12041.

Houston, TX, University of Texas Health Sciences Center, Institute of Environmental Health, Jan. 1974.

Air pollution-particulate emissions-monitoring; Aerosols-properties; Remote sensing;

The feasibility of monitoring atmospheric aerosol characteristics in the respirable range from air or space platforms was explored and demonstrated. The research plan included elements from contrast theory, Mie aerosol characteristics, and a vertical path length, limited by the altitude of the remote sensor platform, an aircraft, or the height of the inversion layer.

Secondary reflectance targets were located in the industrial area and near Galveston Bay. These approximated areas of high and low ambient air aerosol loadings. Film/filter channels were used to limit bandwidths. Multi-channel remote sensor data was processed and utilized to calculate the aerosol extinction coefficient, and thus determine the aeros[illegible]ize distribution.

Houston and Texas air sampling network high-volume suspended particulate data were utilized to generate computer isopleth maps (SYMAPS) of suspended particulates over the test site areas. On-site 5-hour high-volume measurements were also conducted to establish the mass loading of

the atmosphere. In addition a 5-channel nephelometer, and a multi-stage particulate air sampler were used to collect data at the site. After demonstrating the data best fit the Junge distribution, linear regression analyses were used to calculate the extinction coefficient.

20.10-326 551.553.11(261.64)(764)

Sea breeze 1968. *Facilities for Atmospheric Research*, Boulder, Colo., No. 7:24-25, Dec. 1968. Figs. **DAS**—Describes and illustrates the network and procedures used in the continuing study of the sea and land breeze cycles on the Texas Gulf Coast conducted by the Univ. of Texas Atmospheric Science Group. The data-gathering effort was concentrated in June 1968 when special attention was given to 1) energy transfers contributing to the overall heat budget, and 2) a better definition of the land breeze. The network extended in a rough line perpendicular to the shore, from ~14 mi offshore to 11 mi inland. Brief reference is made to the assistance of NCAR: field and flight staff, sensing and power generating equipment, and a Queen Air 80 aircraft. *Subject Headings:* **1. Sea breeze investigations 2. Land and sea breezes 3. Gulf of Mexico 4. Texas, United States.**—*D.B.K.*

Walsh, John E.,
"Sea breeze theory and applications",
J. Atmos. Sci. 31, 2012 (1974).

The linearised Boussinesq equations with rotation, viscosity, conduction, and a mean stratification are used to model the sea breeze in two dimensions. The motion is forced by a prescribed surface temperature function.

The linear model produces a sea breeze with realistic velocities and spatial dimensions. Hydrostatic solutions are found to differ very little from nonhydrostatic solutions. The only distinguishing feature of the solution at the inertial latitude is an amplitude maximum far from the coastline. Both the phase and the amplitude depend on the mean atmospheric stability. The computed vertical heat fluxes, when summed along the coastlines of the principal land masses, indicate that the sea breeze effect can account for several percent of the globally averaged vertical flux of sensible heat at a height of several hundred meters.

The land-sea temperature difference required by the model to create a net onshore flow in opposition to a basic current agrees well with the empirical criterion defined by Biggs and Graves.

The nonlinear advection process is studied with a finite-difference model based on a series of overlapping grids. The principal effect of the nonlinear terms is a landward advection of the sea breeze circulation.

102700
Some Considerations Regarding Rural Ozone
Walker, H. M.
Ozone/Oxidants Interactions with Total Environ. pp.
268-281 Pittsburgh, Pa., Air Pollution Control Assoc. 1976
Doc Type: C; ORIGINAL (THEORETICAL)
CAS Registry No: 10028-15-6

Three local air pollution situations are analyzed. tending to confirm that the transport of urban pollutants can result in the generation of ozone (O3). The Houston plume, the Whiteface Mountain Freon-11 preturbation, and the St. Louis plume were studied. Quantitative results indicate that if O3 generation is being caused by hydrocarbons (HC), concentrations of at most 20 ppb and perhaps considerably less must be responsible. Twenty ppb is less than 10% of the old 240 ppb HC guideline which was once supposed to lead to a maximum of 80 ppb of O3. If 20 ppb or less HC can take a background of 58 ppb of O3 up to 84 ppb within three hours and 78 km as observed, the possible effects of twice as much at 25 km in the suburbs of any major urban area on a less windy day must be considered in the formation of future HC abatement policies. Hydrocarbon levels of an order of magnitude below those previously deemed necessary must be seriously considered. (10 Refs)

Descriptors: ABATEMENT; AIR QUALITY CRITERIA; CRITERIA; HYDROCARBONS; OXIDANTS; POLLUTANTS; OZONE; REACTION MECHANISMS ; CHEMICAL AND PHYSICAL PHENOMENA; RURAL AREAS; NON-METROPOLITAN AREAS; TEXAS; ST LOUIS; TRANSPORT; DISPERSION ; ATMOSPHERIC PHENOMENA

Category: ATMOSPHERIC INTERACTION (CHEMICAL AND PHYSICAL); ATMOSPHERIC INTERACTION; ATMOSPHERIC INTERACTION (METEOROL AND CLIMATOL AND TOPOGR); ATMOSPHERIC INTERACTION

14.7-703 551.575.1:551.575.5:551.515.83(764)

Stevenson, Robert E. (*A. and M. College of Texas*), **Steam fog at Galveston, Texas.** *Weatherwise*, Boston, 15(5):188–191, 213, Oct., 1962. 3 figs., 2 refs.—The terms "norther," "blue norther," "creeping norther," "wet norther" and "smoking norther" as used by the coastal Texas fishermen are defined. The article describes a "smoking norther" observed at Galveston, Texas, on 27 Feb., 1962, when a rapidly moving cold front crossed the coast at noon. The formation of steam fogs in general and the fog at Galveston is discussed and illustrated in graphs for 0900 hrs Feb. 25 to 1200 hrs March 2, 1962 of air temperature and dew point at Galveston Airport and surface water temperatures at the Pleasure Pier on Seawall Drive, Galveston; differences between the vapor pressure of the air and the saturation vapor pressure at the water surface; and differences between the vapor pressure of the air and the saturation vapor pressure at the water surface at 3-hr intervals plotted against the wind velocity measured at the same time. It is concluded that the formation of the steam fog following the frontal crossing was possible only because of a preceding period of warm temperatures. It was the result of a fortuitous sequence of weather and water conditions. *Subject Headings:* **1. Steam fog 2. Galveston, Tex.**—*D.B.K.*

021386

STUDIES OF CARBON MONOXIDE DIFFUSION IN AN URBAN AREA.

Thomas, John Charles

Texas Agricultural and Mechanical Univ., College Station, Dept. of Meteorology, Thesis (M. S.), Jan. 1970, 166p. 28 refs.

1970

FLD BIB Method of Support: NONE

Carbon monoxide as affected by traffic, wind speed, and wind direction near a freeway interchange and in a downtown region was studied. A wide variation was found in the relationships of CO and meteorological conditions from sampler to sampler. Vertical measurements exhibited similar CO concentrations. Rainfall had little effect on reducing CO concentrations. Reasonable results were obtained using an analytic solution, suggesting that CO concentrations close to the source can be determined with a mathematical model. Carbon monoxide concentrations were affected differently by meteorological conditions in a downtown region than in a freeway location. There was a positive correlation between CO and traffic. A negative correlation existed between CO and wind speed, while an almost zero correlation was found between CO and wind direction. (Author conclusions modified)

Descriptors: HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; HIGHWAYS; ROADS; URBAN AREAS; METROPOLITAN AREAS; ENGINE EXHAUSTS; ENGINE EMISSIONS; POLLUTANTS; MOTOR VEHICLE SOURCES; MOBILE EMISSION SOURCES; SOURCES; TRANSPORTATION METHODS; GAS SAMPLING; SAMPLING METHODS; FILTERS; CONTROL EQUIPMENT-GAS STREAMS; CONTROL EQUIPMENT - GAS STREAMS; MATHEMATICAL ANALYSES; MATHEMATICAL MODELING; ANEMOMETERS; METEOROLOGICAL INSTRUMENTS; STATISTICAL ANALYSES; DIFFUSION (ATMOSPHERIC); ATMOSPHERIC PHENOMENA; DISPERSION; METEOROLOGY; WINDS; ATMOSPHERIC MOVEMENTS; HUMIDITY; RAIN; PRECIPITATION; THUNDERSTORMS; TEMPERATURE (ATMOSPHERIC); TURBULENCE (ATMOSPHERIC); CARBON MONOXIDE; OXIDES
Category: ATMOS INTERACT

20.1-177 551.510.42:551.551.8:629.78:779(764)

Randerson, Darryl (*Texas A&M Univ.*), **A study of air pollution sources as viewed by Earth satellites.** *Air Pollution Control Association, Journal*, Pittsburgh, Pa., 18(4): 249-253, April 1968. Figs. **DAS, DLC**—Several photographs are presented which illustrate the large scale dispersion of atmospheric pollutants. These photographs were taken by astronauts on various manned spacecraft flights. A spacecraft view of a forest fire in the Apalachicola Natl. Forest revealed a rather large smoke plume. Geometrically scaled measurements indicated the plume was approximately 4 mi wide and about 65 mi long. Trapped under a frontal inversion located between 2500 and 3000 ft above ground level, this plume was being transported south-southwestward into the Gulf of Mexico by the local wind flow pattern. Several pictures containing examples of industrial smoke plumes in the vicinity of Houston, Tex., are discussed in relation to the local synoptic situation. A picture of industrial haze over Houston, Tex., is presented to illustrate an areal distribution of atmospheric pollutants covering an area of about 2600 mi^2. *Subject Headings:* **1. Atmospheric pollution dispersal 2. Atmospheric pollution sources 3. Satellite photographs of atmospheric pollution 4. Houston, Texas.**—*Auth.*

12.7-249 551.501.81:551.511:551.577.1

*†Clark, Robert A. (*U. S. Dept. of Interior, Denver, Colo.*), **A study of convective precipitation as revealed by radar observation, Texas 1958-59.** *Journal of Meteorology*, Boston, 17(4): 415-425, Aug. 1960. 9 figs., 7 tables, 14 refs. DWB, DLC—Data collected during the summer of 1958 and the late spring and summer of 1959, by use of an AN/CPS-9 radar located in the Department of Oceanography and Meteorology on the campus of the A. & M. College of Texas, were analyzed to study convective precipitation processes. The formation and growth of convective echoes were studied in relation to the mechanisms of precipitation formation. Consideration also was given to day-to-day variations in convective activity. Pronounced variations were noted in echo growth and subsidence, level of first-echo formation and echo movements. It is shown that maximum echo tops are largely dependent on the depth of the moist layer. It is also revealed that precipitation in the Central Texas region is frequently initiated by a process involving only liquid water droplets. *Subject Headings:* **1. Convective precipitation processes 2. Precipitation formation 3. Radar observations 4. Texas.**—***Author's abstract.***

102699
A Study of Factors Associated with High Urban Ozone Concentrations in Texas
Price, James H.
Ozone/Oxidants Interactions with Total Environ. pp. 282-292 Pittsburgh, Pa., Air Pollution Control Assoc. 1976
Doc Type: C; ORIGINAL (FIELD)
CAS Registry No: 10028-15-6

The results of a study of the meteorology and the pollution levels associated with high urban ozone (03) (at least 0.15 ppm) are presented. In 1975, over 80% of the days in Texas with at least 0.15 ppm 03 was monitored in the Houston region and the Southwest Texas region, although only one-half of the Texas Air Control Board 03 monitors are in these two regions. On five of the six occurrences outside these two regions, the concurrent visibility was 12 mi or greater. Twenty-six of the 31 occurrences in the two upper coast regions had visibility less than 10 mi. The one distinguishing meteorological feature common to almost all high 03 occurrences was weak pressure gradients. These results give some support to the hypothesis that the presence of both old photochemical pollution and fresh emissions is normally required to produce high 03 concentrations in Texas, but the relationship is still not well established. (11 Refs)

Descriptors: AIR QUALITY MEASUREMENTS; OXIDANTS; POLLUTANTS; OZONE; PHOTOCHEMICAL REACTIONS; CHEMICAL REACTIONS; CHEMICAL AND PHYSICAL PHENOMENA; PRESSURE (ATMOSPHERIC); METEOROLOGY; ATMOSPHERIC PHENOMENA; TEXAS; UNITED STATES; NORTH AMERICA; AMERICA; URBAN AREAS; METROPOLITAN AREAS; VISIBILITY
Category: ATMOSPHERIC INTERACTION (METEOROL AND CLIMATOL AND TOPOGR); ATMOSPHERIC INTERACTION

18.6-391 551.553.11(764)

George, David H., **Study of the diurnal summer wind system at Galveston, Texas.** *U. S. Weather Bureau, Southern Region Technical Memorandum* No. 30, Dec. 1966. 11 p. Figs., refs., eqs. **DAS** (M(055) U587sot)—An investigation of 30 days hourly wind observations at Galveston Is., Tex. revealed a complex land-sea breeze system. The system is obscured by fairly constant on-shore winds resulting from the western extension of the Bermuda High as well as local effects such as the presence of water on all side of the land area. The large differences in wind direction on the island are theorized to be due to solenoidal effects. *Subject Headings:* **1. Land and sea breezes 2. Galveston, Texas.**—*Auth.*

ID NO.- MGA27020147
Study of the effects of the urban mesoclimate on local and regional pollution potential in southeast Texas.
Pendergast, Malcolm Manley
Grad. Coll., TX. A&M Univ.
Thesis (Ph.D., met.), Aug. 1974. Ann Arbor, MI., University Microfilms, 1975. 208 p. Refs.
CTRY OF PUBL:US

The extent of influence of the pollution plume of Houston, TX., was determined for winter and spring 1972, through several techniques based upon routine meteorological data. One method involved the use of 9-hr trajectories of hypothetical air parcels calculated from adjusted surface winds at 3-hr intervals. Wind speed, stability, and mixing depths obtained from environmental meteorological support unit (EMSU) soundings made at Houston were used to determine the dilution factor (DF) along each trajectory. Another method used to depict the areal extent of the Houston pollution plume was called pollution effect on plants, PEP. This method determined the effect of the Houston pollution plume on a hypothetical biotic plant as a function of DF, temperature, relative humidity, and intensity of sunlight. This research demonstrated an inexpensive technique, at Bryan-College Station, which can be used to acquire information concerning the horizontal and vertical extent of the urban boundary layer. The technique uses instrument platforms-of-opportunity, and the data are collected during the course of automobile transects. Results of the urban survey indicate that the vertical profiles of temperature and humidity within the suburban area are of the same form as profiles measured by other investigators for rural areas. Average lapse rates of temperature at 2300 hr LST for six different locations within the Bryan-College Station urban area show that, during both high and low wind speed conditions, the central business district has a destablizing influence upon the thermal structure of the urban atmosphere. Vertical cross sections of temperature and humidity obtained through use of tower observations were shown to be helpful for the determination of the extent of influence of the urban area. Results indicate that when the urban area is under the influence of a continental polar (cP) or maritime polar (mP) air mass, the effect of the urban area is in the form of an unstable heat plume usually confined within the lowest 60 m. When the urban area is under the influence of a returning polar (RP) or a tropical Gulf (TG) air mass, the effect of the urban area is observed to be above 110 m.

DESCRIPTORS: Atmospheric pollution potentials; Atmospheric pollution dispersal; Urban influences on atmospheric pollution ; Houston, Texas

Decker, C.E., et al.,
Study of the formation and transport of ambient oxidants in the Western Gulf Coast and North-Central and Northeast regions of the United States.
EPA Contract No. 68-02-2048.
Research Triangle Park, NC, Research Triangle Institute, Aug. 1976.

Air pollution-transport mechanisms; Ozone-monitoring; Photochemical pollutants-ground level concentrations; *Photochemical pollutants-monitoring; Air quality-data handling; Air quality-instruments; Air pollution-monitoring; Air pollution-instruments;

17.10-346 **551.553.11(764)**

Eddy, Amos (*Tex. Univ.*), **The Texas coast sea-breeze: a pilot study.** *Weather*, **London, 21(5):162-170, May 1966.** Figs., refs. DAS, DLC—An account of a pilot study of the sea breeze phenomenon on the coast of Texas (Gulf of Mexico) undertaken during the week of June 13-20, 1965. The object was to determine whether or not a sea breeze of sufficient intensity could be found to be distinguishable from the normal on-shore flow prevalent along this particular stretch of coast. Surface and 700 mb charts for June 5, showed that the circulation of that day was such as to provide optimum conditions for the formation of a sea breeze. Time cross sections of the wind speed perpendicular to the beach up to heights of 8000 ft proved the existence of a sea breeze circulation and was confirmed by the diurnal pattern of the variation of the low-level wind direction. The differences in the diurnal temperature curves inland and at the coast, and the effects of the night-time inversion on the wind direction. Other studies were: latent heat produced by lines of heavy Cu in the upward moving section of the circulation may play a significant part in the circulation; sensible-heat profile along a sea-land cross section may not be even close to the space sine wave, temperature gradients could be very sharp along the coast line and very small elsewhere; the role of the sea breeze in the distribution of hygroscopic nuclei may be quite pronounced; and a complete energy-balance picture of the sea breeze, from microscale energy input to mesoscale conversion and transport and then to microscale momentum and kinetic energy loss is a reasonable result to expect from future studies of this phenomenon on the coast of Texas. *Subject Headings:* **1. Sea breeze investigations 2. Sea breeze circulation 3. Texas, United States.**—*R.B.*

Estoque, M.A.,
"A theoretical investigation of the sea breeze",
Quart. J. Roy. Meteor. Soc. 87, 136 (1961).

A primitive equation model is formulated and integrated numerically to study the sea breeze. The formulation is an extension of an atmospheric boundary-layer model previously developed for a homogeneous terrain. External gravity-wave type solutions are suppressed by a modelling assumption involving the equation of continuity. The results of an integration showing the evolution of the sea breeze under conditions of no large-scale synoptic motion are presented.

Fisher, Edwin L.,
"A theoretical study of the sea breeze",
J. Meteor. 18, 216 (1961).

A series of observations of the sea breeze has been made along a portion of the New England coast near Block Island, Rhode Island. These observations were presented in an earlier paper (Fisher, 1960).

With these data as a basis, a dynamical theory of the sea breeze is described and a numerical solution of these sea-breeze equations is obtained. The solution shows the sea breeze in the stages of development and decay and succeeds in reproducing not only the gross features of the wind system but many of its small details as well. The model sea breeze develops a cellular structure similar to the observed system. The depth of the landward branch of the current, its velocity, the velocity of the return current aloft, the elevation, location, and timing of the maximum flow, agree closely with observations. The model also reproduces the rotational effects due to the Coriolis force. The accumulation of error in the model causes its behavior to become irregular by evening (14 hr from its start) so that the development of the low-level jet and other features of the dying system can only be poorly evaluated in the model.

Wexler, Raymond,
"Theory and observations of land and sea breezes",
Bull. Amer. Meteor. Soc. 27, 272 (1946).

THE LOCAL DIURNAL WINDS induced by temperature difference between land and sea are defined as land and sea breezes; the wind that blows from land to sea by night is the land breeze; the wind that blows from sea to land by day is the sea breeze.

With the possible exception of some Arctic and sub-Arctic regions, land and sea breezes occur in coastal regions of continents, islands, or inland lakes. Their frequency on coasts depends essentially upon the latitude, season, cloudiness, and gradient wind. With hilly or mountainous terrain adjacent to the shore, the local winds are a combination of land and sea breezes with valley or slope winds and are thereby stronger and more frequent.

Pielke, Roger A.,
"A three-dimensional numerical model of the sea breezes over South Florida",
Month. Weather Rev. 102, 115 (1974).

An eight-level three-dimensional primitive equation model which includes a detailed boundary layer parameterization scheme has been used to describe the initiation and evolution of sea-breeze convergence patterns over south Florida as a function of the surface heat and momentum fluxes and of the large-scale synoptic forcing. A minimum grid spacing of 11 km was used. Model results are presented for several different initial conditions and the results, when compared against cumulus cloud and shower patterns, demonstrate that the dry sea-breeze circulations are the *dominant* control on the locations of thunderstorm complexes over south Florida on undisturbed days.

It is also shown that, in contrast to the differential roughness, the differential heating between land and water over south Florida is the primary determinant of the magnitudes of convergence. The values of surface roughness, however, indirectly influence convergence patterns by affecting the intensity of the vertical turbulent transport of heat and momentum.

It is found that the sea breeze over south Florida accumulates synoptic-scale moisture in the convergence zones, since the magnitudes of moisture convergence are relatively unaffected by evaporation from the ocean at least for a period of 10 hours or so.

The results of the numerical experiments suggest that, in order to properly interpret the results of the Experimental Meteorology Laboratory's cloud-merger seeding experiments over south Florida, an appreciation and understanding of the sea-breeze circulations are required.

20.2-9 551.553.11(261.64)(764)

McPherson, Ronald D., **Three-dimension numerical study of the Texas coast sea breeze.** *Texas. Univ., Austin. College of Engineering. Atmospheric Science Group. Report* No. 15, Aug. 1968. 252 p. Figs., charts, tables, refs., eqs. DAS (M(051) T3553re) —The effect on the Texas coast sea breeze of irregularities in the coastline, specifically the effect of Galveston Bay, is examined by means of a 3-dimensional mathematical model which is essentially an extension of an earlier 2-dimensional model developed by ESTOQUE. The theory of Estoque's model is examined in detail. A 2-dimensional test version of the model is then subjected to an extensive series of numerical experiments in order to gain some insight into the characteristics of the model and into its response to variations in some of the modeling assumptions. It is demonstrated that computationally stable solutions can be obtained for periods up to 72 hrs. It is also shown that the model is extremely sensitive to variations in the mathematical parametrization of the eddy exchange processes above the boundary layer, and that the formulation of the eddy exchange processes in the boundary layer under stable temperature stratification is inadequate. However, the model simulates many of the observed features of the sea breeze, including intensity and discussions, the sea breeze convergence line, and the clockwise rotation of the horizontal winds with time. Estoque's model is modified on the basis of the experimental evaluation and is extended to three space dimensions. An application to the problem of the effect of Galveston Bay on the sea breeze is undertaken, in which the bay is simulated by a square indentation of an otherwise straight coastline. The results of this application indicate that the presence of Galveston Bay creates a distortion in the sea breeze convergence zone and an asymmetry in the vertical motion field associated with the zone. This asymmetric distribution of vertical motion around the bay is such that the greatest upward motion initially develops northwest of the bay and shifts later to the northeast of the bay. *Subject Headings:* **1. Sea breeze regimes at the coast 2. Sea breeze models 3. Estoque's model 4. Galveston Bay 5. Texas.**—*Auth.*

028852

A TIME AND SPACE STUDY OF POLLUTANTS. (FINAL REPORT).

Griffiths, John F., Malcolm M. Pendergast, D. Randerson, R. C. Runnels, R. Michael Ryan, John C. Thomas, and James T. Zumwalt

Texas Agricultural and Mechanical Univ., College Station, Proj. AP-00611, 144p., Feb. 26, 1971. 33 refs.

1971

FLD BIB Method of Support: RES GRT

A series of papers are presented constituting the final report on an investigation of air pollution and related meteorological parameters in selected urban industrial complexes. A technique was developed for estimating the lower winds (winds up to about 2000 meters) over Houston, Texas, from the currently existing upper air station at Lake Charles, Louisiana. Spatial vector regression, a seldom used statistical technique, was employed. The areal and temporal distribution of pollutant emissions from vehicles in Houston were estimated. A numerical model was proposed for predicting the dispersion of sulfur dioxide over Nashville, Tennessee, during the winter. The model includes the effects of three-dimensional advection, diffusion, and variations in the topography, as well as the effects of chemical decay, source strength, and a correction term for the truncation error. Carbon monoxide measurements were made in the vicinity of a freeway interchange in Houston and in a downtown region of the same city. Activation analysis was used to reveal the distribution of manganes and bromine in an urban area. The spectral distribution of solar radiation in a polluted and a clean air mass was compared. Some preliminary results are presented of an investigation of the dispersion of atmospheric pollutants and the associated pattern of temperatures within the urban area of Houston. An airborne survey was made over Houston to obtain infrared pictures, ultraviolet measurements, infrared data, and temperature profiles. A number of pollutants were tabulated for 55 cities.

Descriptors: SEASONAL; NASHVILLE; AMERICA; NORTH AMERICA; TENNESSEE; UNITED STATES; HOUSTON; TEXAS; HIGHWAYS; ROADS; URBAN AREAS; METROPOLITAN AREAS; ENGINE EMISSIONS; POLLUTANTS; MATHEMATICAL MODELING; MATHEMATICAL ANALYSES; STATISTICAL ANALYSES; LOWER ATMOSPHERE; ALTITUDE; ATMOSPHERIC PHENOMENA;

DISPERSION: METEOROLOGY: ADVECTION: ATMOSPHERIC MOVEMENTS: WINDS; TEMPERATURE (ATMOSPHERIC): TOPOGRAPHIC INTERACTIONS: BROMINE; HALOGEN GASES; MANGANESE COMPOUNDS; METAL COMPOUNDS: CARBON MONOXIDE; OXIDES; SULFUR DIOXIDE; SULFUR OXIDES; SOLAR RADIATION; CHEMICAL AND PHYSICAL PHENOMENA: LIGHT RADIATION
Category: ATMOS INTERACT; MEASUREMENT METH

ID NO.- MGA24010353
Turbulent fluxes and associated spectra in a sea breeze boundary layer.
Hembree, Louis A., Jr.
Texas. Univ., Austin. Atmospheric Science Group. Report No. 29, Aug. 1971. 90 p.
CTRY OF PUBL:US
DOC TYPE: o

During three days in July 1968, wind and temperature fluctuation data were taken for the calculation of turbulent fluxes of momentum and sensible heat in a sea breeze regime. The experimental site was located on the upper Texas Gulf coast east of Galveston, Texas. The data were taken with a bivane anemometer and thermocouple mounted at a height of approximately 8 m on a tower located 90 m inland from the shore. The eddy-correlation technique was used to calculate the turbulent fluxes of sensible heat and momentum. In addition, a spectral analysis was performed on the data.

DESCRIPTORS: Heat flux; Momentum flux; Turbulent exchange in lower-atmosphere; Sea breeze turbulence; Galveston, Texas
UCD NO:551.551.8:551.553.11

050657
URBAN EFFECTS ON THUNDERSTORM AND HAILSTORM FREQUENCIES.
Changnon, Stanley A., Jr.
Preprint, American Meteorological Society, Boston, Mass., p. 177-184, 1972. 8 refs. (Presented at the Conference on Urban Environment and Second Conference on Biometeorology, Philadelphia, Pa., Oct. 31-Nov. 2, 1972.)
CONF URBAN ENVIRON SECOND CONF BIOMETEOROL PHILADELPHIA PA 1972
FLD Method of Support: NONE

The effects of aerosols, heat, moisture, and mechanical turbulence on convective processes over and immediately downwind of urban-industrial areas were investigated. Historical (1901-1969) thunder-day and hail-day records for regions in and around eight cities were used to establish the existence of alterations in their frequencies, and to identify the causes. The cities investigated included Chicago, Indianapolis, St. Louis, Cleveland, Washington, D. C., Tulsa, Houston, and New Orleans. The investigation was based on all available Weather Bureau station records in and within 60 mi of each city. The basic analytical approach involved both spatial and temporal analyses of the frequencies of the events. The data, the changes (increase) found in each city, the geographical distributions of the areas with the increases, the periods when the increases began, and the possible relationships of the increase to various synoptic conditions and urban factors were evaluated. Thunder and hail-day frequency increases were found in the six largest cities investigated. The results suggested that a critical size of urban area (over 900,000 population) must be reached before an urban area can affect severe storm frequency. The results also suggested that local increases in thunder frequencies will increase 30% as the city population exceeds 3 million.

Descriptors: CHICAGO; AMERICA; ILLINOIS; NORTH AMERICA; UNITED STATES; INDIANA; NEW ORLEANS; LOUISIANA; ST LOUIS; MISSOURI; OHIO; OKLAHOMA; HOUSTON; TEXAS; WASHINGTON D C; URBAN AREAS; METROPOLITAN AREAS; INDUSTRIAL AREAS; AEROSOLS; PARTICULATES; POLLUTANTS; MATHEMATICAL ANALYSES; CONVECTION (ATMOSPHERIC); ATMOSPHERIC MOVEMENTS; ATMOSPHERIC PHENOMENA; METEOROLOGY; WINDS; HUMIDITY; THUNDERSTORMS; PRECIPITATION; TEMPERATURE (ATMOSPHERIC); WEATHER MODIFICATION; TOPOGRAPHIC INTERACTIONS; TURBULENCE (ATMOSPHERIC); INDIANA; OHIO; OKLAHOMA; PRECIPITATION

Identifiers: INDIANAPOLIS; CLEVELAND; TULSA; HAILSTORMS

Category: ATMOS INTERACT

ID NO.- MGA28100517

Urbanization and climatic change.

Goldman, Joseph L.

Intl. Ctr. for Solution of Environ. Problems, Houston, TX.

. Urban costs of climate modification. Ed. by Terry A. Ferrar. N.Y., John Wiley & Sons, 1976. p. 43-101. Refs. DAS (A QC 928 U7)

CTRY OF PUBL:US

The well known effects of urbanization upon the climate of cities and of surrounding areas are discussed by examining the influence of the city structure upon meteorological variables and processes and considering in particular the effect on precipitation and the verification of this effect. The importance of the urban influence as a factor in climatic change is investigated by examining in detail the climatic effects in Houston and comparing these effects by relating them to similarities of climatic change in urban South African areas. Extensive data on the climatic variables in Houston are given in graphs. The interaction of climatic change by urbanization and natural climatic change is discussed.

DESCRIPTORS: Urban climatology; Houston, Texas

010083
AIR POLLUTION AND PROTECTIVE COATINGS: HOUSTON. DALLAS. AND WASH- INGTON.
Fiero. George W.
J. Paint Technol.. 40(520):222-228. May 1968. 18 refs.
J PAINT TECHNOL 1968
TECH Method of Support: FELL GRT

In general, man-made air pollutants are largely products of combustion, and solvents from protective coatings are not major air pollutants. Photochemical smog prevalent in Los Angeles results fro inter-reaction between oxides of nitrogen. reactive hydrocarbons, a oxygen. Hydrocarbons vary greatly in their reactivity; hydrocarbo found in solvents are less reactive than auto exhaust. Data are provided on common air pollutants in Houston, Dallas, Ft. Worth, an Washington. Rule 66 and its definition of photochemically reactive solvents are examined with respect to the use of protective coating in the San Francisco Bay Area. Where federal specifications apply. the Bay Area Air Pollution Control District has agreed to draw up a variance to January 24. 1969. So far. Rule 66-type regulations hav not been adopted anywhere other than California. The New York, New Jersey and Pennsylvania regulations and proposed rules are discusse Industry must cooperate with local authorities to reduce general a pollution. The National Paint, Varnish and Lacquer Association smo chamber at Batelle Memorial Institute should provide data relative the extent solvents add to photochemical smog.

Descriptors: SURFACE COATINGS; MATERIALS; LACQUERS; PAINTS; VARNISHES AND SHELLAC; CALIFORNIA; AMERICA; NORTH AMERICA; UNITED STATES; LOS ANGELES; SAN FRANCISCO; NEW JERSEY; NEW YORK STATE; NEW YORK CITY; PENNSYLVANIA; TEXAS; HOUSTON; POLLUTANTS; SOLVENTS; SOURCES; INDUSTRIAL EMISSION SOURCES; STATIONARY EMISSION SOURCES; PAINTS AND ALLIED PRODUCTION; CHEMICALS AND ALLIED MANUFACTURING; MANUFACTURING INDUSTRIES; SURFACE COATING OPERATIONS; ALCOHOLS; HYDROCARBONS; ALIPHATIC HYDROCARBONS; AROMATIC HYDROCARBONS; LEGAL ASPECTS; CODES; REGULATIONS
Category: LEGAL AND ADMIN

008062
AIR POLLUTION CONTROL ACTIVITIES ARE NOTED FOR 23 INDUSTRY AREAS.
Schildhammer, Allen
Air Eng., 9(6):28-34, 37, June 1967.
AIR ENG 1967
TECH Method of Support: FELL GRT

A spot check of air pollution control activities in key industrial areas throughout the United States and Canada shows that industry, by and large, is cooperating to a great extent in investing in abatement devices. The survey also indicates that Air Pollution Control Authorities are becoming more active and vigorous in their activities to evaluate their local and regional air pollution problems. On the whole the budgets for the Authorities are on the increase, and this is coupled with increases in Federal grants. Also, many states, regions, and cities which did not have adequate air pollution control laws and regulations are updating those already on the books, and passing new ones to keep abreast of new technology and current developments in this field. The industrial areas included in this second annual survey are : Little Rock, Arkansas, Seattle-King County, Washington, Houston, Texas, Miami (Dade County), Florida, Chicago, Illinois, Portland, Oregon, Vancouver, British Columbia, Cincinnati, Ohio, Gary, Indiana, St. Louis, Missouri, Minneapolis, Minnesota, Oklahoma City, Oklahoma.##

Descriptors: CONSTRUCTION MATERIALS; MATERIALS; ASPHALT; CEMENTS; METALS; ALUMINUM; IRON; STEEL; PAPER CHROMATOGRAPHY; ANALYTICAL METHODS; CHROMATOGRAPHY; REFRACTORIES; RUBBER; ARKANSAS; AMERICA; NORTH AMERICA; UNITED STATES; OHIO; CINCINNATI; OKLAHOMA; OREGON; RHODE ISLAND; TEXAS; HOUSTON; WASHINGTON (STATE); WISCONSIN; URBAN AREAS; METROPOLITAN AREAS ; INDUSTRIAL AREAS; POLLUTANTS; COMBUSTION PRODUCTS; ASHES; CINDERS; COMBUSTION GASES; STACK GASES; WASTE GASES; PARTICULATE CLASSIFICATION METHODS; PARTICULATES; SETTLING PARTICLES; DUSTS; SUSPENDED PARTICULATES; SMOKES; SOURCES; FURNACES; STATIONARY EMISSION SOURCES; INDUSTRIAL EMISSION SOURCES; CHEMICAL PROCESSES; KRAFT (SULFATE) PULPING; MANUFACTURING INDUSTRIES; PAPER AND ALLIED MANUFACTURING; PULP MILLS; RENDERING PLANTS, GREASE AND TALLOW; FAT AND OIL PRODUCTION; FOOD AND KINDRED PRODUCTS INDUSTRY; INCINERATORS (REFUSE); ELECTRIC, GAS, AND SANITARY SERVICES; REFUSE SYSTEMS ; SANITARY SERVICES; ODORS; ELECTRIC POWER GENERATION; STEAM ELECTRIC POWER GENERATION; NON-INDUSTRIAL EMISSION SOURCES (STATIONARY); DOMESTIC HEATING; DUMPS; TRANSPORTATION METHODS; MOBILE EMISSION SOURCES; MOTOR VEHICLE SOURCES; AUTOMOBILES; LIGHT-DUTY VEHICLES; CONTROL EQUIPMENT - GAS STREAMS; INCINERATORS (WASTE GASES); CONTROL EQUIPMENT-GAS STREAMS; COLLECTORS (MECHANICAL); ELECTROSTATIC PRECIPITATORS; FILTERS; BAG FILTERS; FABRIC FILTERS; SCRUBBERS; CARBON MONOXIDE; OXIDES; SULFUR OXIDES; SULFUR DIOXIDE; ABATEMENT; ADMINISTRATION; BUDGETING; GRANTS; PLANS AND PROGRAMS; CONTROL PROGRAMS; COSTS; ECONOMICS; GOVERNMENTS; CITY GOVERNMENTS; COUNTY GOVERNMENTS; NATIONAL GOVERNMENTS; REGIONAL GOVERNMENTS ; STATE GOVERNMENTS; LEGAL ASPECTS; LEGISLATION; CLEAN AIR ACT ; ARKANSAS; CALIFORNIA; CANADA; COLORADO; FLORIDA; INDIANA;

MINNESOTA; OHIO; OKLAHOMA; OREGON; RHODE ISLAND; TEXAS; WASHINGTON (STATE); WISCONSIN

Identifiers: LITTLE ROCK; SAN BERNARDINO COUNTY; MONTREAL; TORONTO, ONTARIO; VANCOUVER, BRITISH COLUMBIA; DENVER; MIAMI (DADE COUNTY); EAST CHICAGO; GARY; MINNEAPOLIS; AKRON-BARBERTON; COLUMBUS; DAYTON; OKLAHOMA CITY; PORTLAND; PROVIDENCE; FORT WORTH; SEATTLE-KING COUNTY; MILWAUKEE COUNTY. MILWAUKEE

Category: LEGAL AND ADMIN

Randall, Albert G.,
Air Pollution Control, annual report for 1974.
Houston, Tx., City of Houston, Health Department, 1975.

Texas-air pollution; Air pollution-control methods; *Houston, Texas-air pollution;

Houston's Division of Air Pollution Control has changed radically since its initiation in 1968, however, its main objective of enhancing Houston's air quality has remained foremost in its activities. From a wet chemical analysis which required 48 hours to a real-time system involving sophisticated instrumentation, our ability to analyze Houston's air quality has advanced to a point of on-the-spot knowledge of air pollutant levels.

Seven years of growth have taken us from a fledgling operation to an agency unrivaled by any local Air Pollution Control Program in the nation. Money and manpower increases have aided in our attempts to achieve cleaner air for Houston's citizenry.

Our tasks are tremendous. The number of stationary sources which contribute to air pollution are in the tens of thousands, however, the solutions and technology for reduction of contaminants are available and time, money, and enforcement of our air pollution laws will achieve for Houston the air quality desired.

103415
Air Pollution Control in the Chemistry Industry
Rickles, Robert N.
Air Pollut. Control Guideb. for Manage. pp. 151-156
Stamford, Conn., E.R.A. Inc. 1969
Note: (A. T. Rossano, Jr., ed.)
Doc Type: C; Reviews (Technical)

In order to indicate all possible aspects of air pollution control in the chemical industry, several examples are cited, and the control requirements in specific industrial problem areas are given. In the planned construction of a large petrochemical complex near a major Gulf Coast metropolitan areas, preconstruction survey and review results are presented. Another power plant was creating a nuisance problem among its residential neighbors through its particulate matter emissions. The problem of solvent recovery occurs in many industrial operations which use large amounts of solvents which create difficult local air pollution and industrial hygiene problems. An additional problem is presented which occurred at a petrochemical plant along the Texas Gulf Coast. Mist from the cooling tower blew over a public highway, in violation of the State Code, and created a traffic hazard. The solution to the problem involved the use of gas burners to heat the exiting gas at the cowls. This increased the exit gas temperature and gas dispersion, thus eliminating the problem. The problem of odor is highlighted by a chemical facility which produced a large number of odorous chemicals, and these produced a serious odor problem. Sulfur oxides problems are highlighted in a study from a plant power facility utilizing a 1.5%+ sulfur containing fuel oil. Other industrial problems discussed specifically include phosphoric acid, sulfuric acid, nitric acid, and kraft mill production.

Descriptors: Safety; Pollutants; Odorous Pollutants; Particulates; Suspended Particulates; Mists; Solvents; America ; North America; United States; Texas; Metropolitan Areas; Residential Areas; Roads; Highways; Control Methods; By-Product Recovery; Sources; Stationary Emission Sources; Cooling Towers; Fuel Characteristics; Fuel Sulfur Content; Fuels; Fuel Oils; Industrial Emission Sources; Electric, Gas, and Sanitary Services; Electric Power Generation; Manufacturing Industries; Chemicals and Allied Manufacturing;

BIBLIOGRAPHY (continued)
CONTROL

Agricultural Chemical Plants; Nitrogeneous Fertilizer Plants; Nitric Acid Plants; Phosphatic Fertilizer Plants; Phosphorus Acid Plants; Industrial Inorganic Chemical Plants; Sulfuric Acid Plants; Paper and Allied Manufacturing; Pulp Mills; Kraft (Sulfate) Pulping; Petroleum and Coal Products Industry; Atmospheric Phenomena; Dispersion; Oxides; Sulfur Oxides
Category: Control Methods (Categorical); Control Methods (General Stationary Source)

Houston, City of, Texas, Dept. of Public Health,
Air Pollution Control Program, CHAMPS CAMS, draft report. undated.

Houston, Texas-air pollution;

The continuous monitoring program of the Air Pollution Control Division is primarily responsible for the city-wide determination of ambient air concentrations. Such determination of ambient data is an essential part of any reasonable and effective air pollution control program. This information is required for planning and decision making within every phase of the control program.

Randall, Albert G.,
Air Pollution Control Program for 1975.
Houston, Tx., City of Houston, Health Dept., undated.

*Texas-air pollution; Air pollution-control methods; Houston, TX-air pollution;

Houston, City of, Texas Dept. of Public Health, Pollution Control Division,
Air Pollution Control Program, second quarter report, 1975.
undated.

*Houston, Tx.-air pollution; Texas-air pollution;

Houston, City of Texas, Health Dept., Air Pollution Control Program,
Air Pollution Control Program, fourth quarter report, 1976.
Houston, TX, undated.

Houston, TX-air pollution;

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CONTROL

Houston, City of, Texas, Dept. Public Health, Pollution Control Division, Air Pollution Control Program first quarter report, 1977.

*Houston, Texas-air pollution; Texas-air pollution-transportation control plans; Texas-air pollution-regulations;

Houston, City of, Department of Public Health, Air Pollution Control Program 1977, second quarter report, Houston, 1977.

*Houston, Texas-air pollution; Air pollution-health effects; Texas-air pollution;

Houston, City of, Texas, Department of Public Health, Air Pollution Control Program, third quarter report. Houston, TX, 1977.

*Houston, Texas-air pollution; Air pollution-monitoring; Air quality-data; Air pollution-control methods;

Houston, City of, Department of Public Health, Pollution Control Division, Air Pollution Control Program 1977, fourth quarter report. Houston, TX, undated.

*Houston, Texas-air pollution; Texas-air pollution; Air pollution-air quality maintenance plans;

Houston, City of, Dept. of Public Health, Pollution Control Division, Air Pollution Control Program, 1978, first quarter report. Houston, TX, 1978.

078786

APPROVAL AND PROMULGATION OF IMPLEMENTATION PLANS. SHIP AND BARGE VAPOR RECOVERY.

Train, Russell E.

Federal Register, 40(82):18437-18438, April 28, 1975.

FEDERAL REGISTER 1975

TECH Method of Support: INHOUSE

The suspension of interim compliance dates for regulations on ship and barge vapor recovery is announced. The regulations require recovery of vapors emitted during loading and unloading of gasoline and other volatile compounds from ships and barges in the Houston-Galveston Intrastate Air Quality Control region. The purpose is to reduce hydrocarbon emissions and to assist in the attainment and maintenance of the national ambient air quality standard for photochemical oxidants in that region. Interim dates for compliance are suspended, but the final compliance date of May 31, 1975 remains in effect.

Descriptors: COMPLIANCE SCHEDULES; ADMINISTRATION; CONTROL PROGRAMS; PLANS AND PROGRAMS; REGULATIONS; LEGAL ASPECTS; AIR QUALITY STANDARDS; STANDARDS; OXIDANTS; POLLUTANTS; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; VESSELS (MARINE) ; MOBILE EMISSION SOURCES; SOURCES; TRANSPORTATION METHODS; GASOLINES; FUELS; STATIONARY EMISSION SOURCES; PETROLEUM DISTRIBUTION; INDUSTRIAL EMISSION SOURCES; HYDROCARBONS; VAPORS; CHEMICAL AND PHYSICAL PHENOMENA; PHYSICAL STATES

Category: LEGAL AND ADMIN

080099

APPROVAL AND PROMULGATION OF IMPLEMENTATION PLANS. SUBPART SS-TEXAS. SHIP AND BARGE VAPOR RECOVERY. SUSPENSION OF COMPLIANCE DATE.

Train, Russell E.

Federal Register, 40(198):47765, Oct. 10. 1975.

FEDERAL REGISTER 1975

TECH Method of Support: INHOUSE

The compliance date for a final regulation requiring recovery of vapors emitted during loading and unloading of gasoline and other volatile compounds from ships and barges in the Houston-Galveston Intrastate Air Quality Control region is suspended. The final compliance date is suspended pending proposal and final publication of amendments. This action does not relieve those subject to the regulation from the obligation to continue to make maximum good faith efforts to comply with the substantive portions of the regulation. This suspension is in effect until March 1. 1976. or until final publication of amendments to the regulation. whichever is earlier.

Descriptors: COMPLIANCE SCHEDULES; ADMINISTRATION; CONTROL PROGRAMS; PLANS AND PROGRAMS; REGULATIONS; LEGAL ASPECTS; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; VAPOR RECOVERY SYSTEMS; CONTROL EQUIPMENT-GAS STREAMS; VESSELS (MARINE); MOBILE EMISSION SOURCES; SOURCES; TRANSPORTATION METHODS; GASOLINES; FUELS; STATIONARY EMISSION SOURCES; MATERIALS HANDLING; VAPORS; CHEMICAL AND PHYSICAL PHENOMENA; PHYSICAL STATES

Category: LEGAL AND ADMIN

005347
CO BOILER AND FLUIDIZED-BED STEAM SUPERHEATER ON SINCLAIR REFINING COMPANY'S NEW FLUID UNIT AT THE HOUSTON REFINERY.
Campbell, O. F. and Pennels, N. E.
American Soc- iety of Mechanical Engineers, New York 77, 927-38 (Aug. 1955). (Presented at the Annual Meeting, American Society of Mechan- ical Engineers, New York City, Nov. 28-Dec. 3, 1954, Paper No. 54-A-20.)
1955
TECH Method of Support: FELL GRT
Approximately 400,000 lb per hr of 550-psig, 750 F total temperature steam production is a unique feature of Sinclair Refining Company's new fluid catalytic-cracking unit at its Houston, Texas, Refinery. Over 300,000 lb per hr of 700-psig saturated steam are produced on the oil industry's first direct- fired unit to recover both the sensible heat and the heat of combustion from the high-temperature regenerator-exit flue gas. The heat of combustion of the regenerator-exit flue gas is derived from its CO content. Saturated steam produced on the boiler is superheated to 750 F total temperature in industry's first fluidized-bed respray steam superheater. The superheater-respray feature produces approximately 100,000 lb per hr of additional steam and allows simultaneous control of both the regenerator-bed temperature and the steam superheat. Other advantages are: prevents the CO gas from escaping and possible pollution of the atmosphere; precludes the possibility of unburned hydrocarbons or malodorous gases, or other gases that may cause air pollution, from escaping to the atmosphere; and conditions the flue gases for subsequent removal of particulate matter.
Descriptors: TEXAS; AMERICA; NORTH AMERICA; UNITED STATES; HOUSTON; SOURCES; BOILERS; STATIONARY EMISSION SOURCES; INDUSTRIAL EMISSION SOURCES; CHEMICAL PROCESSES; PETROLEUM REFINING; MANUFACTURING INDUSTRIES; PETROLEUM AND COAL PRODUCTS INDUSTRY; PILOT PLANTS; CONTROL METHODS; CARBON MONOXIDE; OXIDES
Category: CONTROL METHODS

017614
CITY PLANNING, INDUSTRIAL-PLANT LOCATION, AND AIR POLLUTION.
Katz, Morris
In: Air Pollution Handbook. P. L. Magil, F. R. Holden, and C. Ackley (eds.), New York, McGraw Hill, 1956, Sect. 2, 53p. 68 refs.
AIR POLLUTION HANDBOOK 1956
TECH BIB Method of Support: NONE
Detroit, Philadelphia, Pittsburgh, Los Angeles, and Houston are cited as examples of cities that have made extensive improvements through city planning. In 1953 there were 75 people in New York City employed by Air Pollution Control, and the budget was about $375,000. The history of pollution control efforts is described for Great Britain, St. Louis, Pittsburgh, Los Angeles, and Detroit-Windsor. The role of meteorological factors is considered, with an enumeration of 6 basic principles of control in the designing of smokestacks. Topographical influence is discussed for Trail, B. C. and Los Angeles. Figures are given on fallout of dust and gas concentrations for various ubran areas. Gases discussed

include sulfur dioxide, hydrogen sulfide, hydrogen fluoride, hydrogen chloride, organic sulfides, aldehydes, and smog.

Descriptors: LOS ANGELES; AMERICA; CALIFORNIA; NORTH AMERICA; UNITED STATES; CANADA; GREAT BRITAIN; EUROPE; UNITED KINGDOM; WESTERN EUROPE; DETROIT; MICHIGAN; NEW YORK CITY; NEW YORK STATE; PHILADELPHIA; PENNSYLVANIA; PITTSBURGH; HOUSTON; TEXAS; INDUSTRIAL AREAS; URBAN AREAS; METROPOLITAN AREAS; DUSTS; PARTICULATES; POLLUTANTS; SETTLING PARTICLES; SMOG; SUSPENDED PARTICULATES; STACKS; SOURCES; DUST FALL; AIR QUALITY MEASUREMENTS; SOOT FALL; DESIGN CRITERIA; METEOROLOGY; ATMOSPHERIC PHENOMENA; TOPOGRAPHIC INTERACTIONS; HYDROCHLORIC ACID; ACIDS; INORGANIC ACIDS; HYDROFLUORIC ACID; ALDEHYDES; SULFUR ORGANIC COMPOUNDS; SULFUR DIOXIDE; OXIDES; SULFUR OXIDES; HYDROGEN SULFIDE; SULFIDES; SULFUR COMPOUNDS; PLANS AND PROGRAMS; ADMINISTRATION; CONTROL AGENCIES; PLANNING AND ZONING; LEGAL ASPECTS

Category: LEGAL AND ADMIN

015237
THE CONTROL OF AIR POLLUTION IN TEXAS.
Paganini, Otto
Texas Business Rev., 43(3): 6p., March 1969. 3 refs.
TEXAS BUSINESS REV 1969
TECH Method of Support: NONE

Because the state has an abundance of combustible gas fuels, Texas does not have the degree of air pollution found in solid and liquid fuel burning areas of the country. However, photochemical smog is beginning to develop in major population centers. An example is the Houston-Harris County area, where pollutant buildup occurs during low-level temperature inversions from October through March. The Fort Worth-Tarrant County and Dallas City-County areas are also experiencing some pollution problems. Local air pollution control programs, as well as state programs directed by the Texas Air Control Board, are maintaining surveillance in these areas and working to reduce emissions from major sources such as cotton gins, smelters, foundries, petroleum refineries, and petrochemical industry, refuse burning at public disposal sites, and automobile exhausts. Activities of local programs include the operation of high-volume and 'effect-package' types of air sampling stations which collect samples on a weekly, biweekly, and monthly basis. The Air Control Board, established by the Clean Air Act of Texas (1965), is empowered to establish air quality criteria and to determine levels and emission limits for pollutants. The Board must support local governments in all suits against violators of emission standards.

Descriptors: TEXAS; AMERICA; NORTH AMERICA; UNITED STATES; CONTROL PROGRAMS; ADMINISTRATION; PLANS AND PROGRAMS; CONTROL AGENCIES; LOCAL GOVERNMENTS; GOVERNMENTS; STATE GOVERNMENTS; CLEAN AIR ACT; LEGAL ASPECTS; LEGISLATION

Category: LEGAL AND ADMIN

027093

COOLING TOWER FOG: CONTROL AND ABATEMENT.

Veldhuizen, Hennie and Joe Ledbetter

Preprint. Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1970. 21 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-41.)

AIR POLLUTION CONTROL ASSOC ANNU MEET 63RD ST LOUIS MO 197 1970

TECH BIB Method of Support: NONE

Cooling towers frequently produce fogs during near freezing weather causing visibility and/or icing hazards on adjacent streets or roads. Records for December 1967 to March 1969 indicate that fourteen episodes of visibility restricting fog were noted for generally short periods in the vicinity of two cooling towers at a refinery in Houston, Texas. Several possible methods of solving the cooling tower fog problem are discussed, with emphasis placed on the estimated costs of the most promising techniques. The addition of heat to the cooling tower exhaust facilitates dispersio of the plume before condensation occurs, and the cost for superheating the plume sufficiently to prevent fog formation is $40,000 for estimated capital and installation expenses and $16,000 for operating expenses. Heat could be transferred to the air by passing the hot water through finned heat exchangers replacing the lattice fill within the cooling tower at an estimated $36,000 and $40,000 for capital costs and installation with operating costs at $100,000. Another design based on an externally mounted finned unit extending along the full length of the towers is expected to cost $19,500 and $22,000 for capital and installation expenses with operation costs at $3000. Another possible method is to waste 26,000 gpm of hot water and replace this amount with 60 F makeup water. Several other possible but not so probable solutions are indicated. Rather than evaporate a cooling tower completely, sufficient added heat to elevate the plume over an adjacent thoroughfare has been achieved in a number of areas. Annual costs estimated for such a system are $14,800 for capital expenditures and $6500 for operating costs. Air cleaning methods are also mentioned.

Descriptors: ABATEMENT; COSTS; ECONOMICS; CANADA; AMERICA; NORTH AMERICA; STREETS; ROADS; PETROLEUM REFINING; INDUSTRIAL EMISSION SOURCES; MANUFACTURING INDUSTRIES; PETROLEUM AND COAL PRODUCTS INDUSTRY; SOURCES; STATIONARY EMISSION SOURCES; CHEMICAL PROCESSES; OPERATING VARIABLES; VISIBILITY; AIR QUALITY MEASUREMENTS; CONTROL METHODS; DESIGN CRITERIA; PLUME BEHAVIOR; ATMOSPHERIC PHENOMENA; DISPERSION; FOG; CONDENSATION (ATMOSPHERIC); METEOROLOGY; COOLING; CHEMICAL AND PHYSICAL PHENOMENA; HEAT TRANSFER; COOLING

Identifiers: COOLING TOWER

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CONTROL

Radian Corporation,
DM-1 Uniform Data Bas Design, **draft report.**
DCN 77-100-144-03, Radian Project No. 100-144.
Austin, Tx., Jan. 1977.

Photochemical pollutants; *Houston, Tx. air pollution;

The Houston Chamber of Commerce has initiated the Houston Area Oxidants Study (HAOS) to evaluate the impact of airborne oxidants on the social, economic, and environmental communities in the Houston area. This study will involve the collection of a diverse and extensive set of air quality and meteorologica data for the Houston area. To provide for efficient analysis of this extensive data base, this report describes the structure and organization of the data to be utilized for computer storage and processing.

"Formation and Transport of Secondary Air Pollutants: Ozone and Aerosols in the St. Louis Urban Plume," ***Science* *194*, 187 1976.**

102717
Fuel Conversion Strategy Impacts on Compliance with Photochemical Oxidant Standards
Gautam, Sulaksh R.; Cooper, Hal B. H., Jr.
Ozone/Oxidants Interactions with Total Environ. pp. 63-76
Pittsburgh, Pa., Air Pollution Control Assoc. 1976
Doc Type: C; ORIGINAL (THEORETICAL)
CAS Registry No: 10028-15-6

Fuel conversion impacts on photochemical oxidant standard compliance were projected for Los Angeles and Houston by switching from natural gas to fuel oil and coal, respectively. Increased fuel oil combustion in the South Coast Air Basin of California could simultaneously increase sulfate aerosol concentrations and photochemical oxidant levels in the absence of greater fuel oil or stack gas desulfurization processes, because of predominance of the photochemical oxidant mechanism. Increased coal and oil combustion in Houston may result in increased sulfate aerosol levels but also decreased oxidant levels because of the probable predominant chemical oxidation in the humid atmospheres to result in a net ozone (O3) consumption. Extensive transportation electrification in the South Coast Air Basin of California could substantially reduce photochemical oxidant levels, but would have less impact in Houston because of the greater relative emission contributions of transportation with the greater industrial base. (12 Refs)

Descriptors: AIR QUALITY STANDARDS: STANDARDS: COMBUSTION PRODUCTS: FUEL OILS: FUELS: STATIONARY EMISSION SOURCES: SOURCES: FUEL SUBSTITUTION: FIRING METHODS: PROCESS MODIFICATION: CONTROL METHODS: IMPACT STATEMENTS: ADMINISTRATION: LOS ANGELES: CALIFORNIA: UNITED STATES: NORTH AMERICA: AMERICA: OXIDANTS: POLLUTANTS: OZONE: SULFATES: SULFUR COMPOUNDS: TEXAS
Category: CONTROL METHODS (FUEL TREATMENT AND FUEL CONVERSION): CONTROL METHODS (CATEGORICAL)

Houston Chamber of Commerce,
Houston Area Oxidants Study, Six Month Status Report.
DCN 77-100-144-05.
Houston, TX, May 1977.

Photochemical oxidants; Photochemical oxidants-control strategies; *Houston-air pollution:

The Houston Area Oxidants Study (HAOS) is a technica study composed of a group of separate, interrelated projects. The study investigates the causes and impacts of airborne oxidants and haze in Houston and Southeast Texas. It is an effor to develop a sound technical basis for controlling haze and ai borne oxidants in the area.

The two-year study has progressed through the tasks planning and organization and into execution of technical projects. This report describes the status of the HAOS at the en of six months of activity.

Houston, City of, Chamber of Commerce,
Houston Area Oxidants Study twelve month status report.
DCN 77-100-144-11, HAOS Contract.
Houston, Nov. 1977.

*Houston, Texas-air pollution; Texas-air pollution; Air pollution-health effects; Air pollution-social and economic effects; Haze; Photochemical pollutants-control strategies; Ozone-control strategies;

Houston, City of, Texas, Chamber of Commerce,
Houston Area Oxidants Study, eighteen month status report.
DCN 78-100-144-14, HAOS Contract.
Houston, May 1978.

041673
HUMBLE S APPROACH TO POLLUTION CONTROL.
Ferguson, H. W.
Proc. Am. Petrol. Inst., Sect. III, vol. 36:304-305, 1956.
PROC AM PETROL INST SECT III 1956
FLD Method of Support: NONE

Air pollution problems at a 280,000 bbl/day oil refinery located in the Houston Ship Channel are corrected by installing alternate processes which eliminate contaminants at the source whenever such measures are economically justified by otherwise needed modernization. This has included construction of a hydrogen sulfide-to-sulfur conversion unit which in 1954 recovered 12,000 long tons of sulfur from refinery gases. Waste disposal facilities are included in the base plans/for all new plant units. A Pollution Abatement Committee reviews all new process and modernization plans to insure that adequate waste disposal facilities are provided, coordinates pollution control efforts, and disseminates information on new abatement techniques. An Operating Committee maintains close supervision of all waste- disposal operations. Employees, the public, and the control authorities are kept informed of the abatement program, and all complaints are analyzed thoroughly. In the past 7 years, $4 million for air pollution control and $5 million for water pollution control has been spent at this plant. (Author abstract modified)

Descriptors: CONTROL PROGRAMS; ADMINISTRATION; PLANS AND PROGRAMS; COMMERCIAL FIRMS; COSTS; ECONOMICS; STACK GASES; POLLUTANTS; WASTE GASES; COMBUSTION GASES; COMBUSTION PRODUCTS ; PETROLEUM REFINING; INDUSTRIAL EMISSION SOURCES; MANUFACTURING INDUSTRIES; PETROLEUM AND COAL PRODUCTS INDUSTRY ; SOURCES; STATIONARY EMISSION SOURCES; CHEMICAL PROCESSES; CONTROL METHODS; BY-PRODUCT RECOVERY; HYDROGEN SULFIDE; SULFIDES; SULFUR COMPOUNDS

Category: CONTROL METHODS

Dimitriades, Basil, ed.,
International Conference on Photochemical Oxidant Pollution and its Control, proceedings, 2 vols.
EPA 600/3-77-001 a,b.
Research Triangle Park, N.C., EPA, Environmental Sciences Research Lab., Jan. 1977.

Proceedings; *Photochemical pollutants; Photochemical pollutants-control strategies; Photochemical pollutants-standards; Air pollution-health effects;

Intensive studies conducted in the past 3-4 years have resulted in an abundance of suggestive evidence that in part supported and in part refuted the earlier understanding, but did not resolve all existing issues. Thus, the international scientific community is still divided on the issue of the justification of the 0.08-ppm ambient air quality standard for oxidant, one objection arising from the questionable achievability of such a standard. A newly revived issue of major importance pertains to the relative roles of the hydrocarbon and nitrogen oxide precursors in the urban and rural oxidant formation processes. The viewpoint of the U.S. Environmental Protection Agency supporting maximum control of the hydrocarbon and limited control of the NO_x emissions is challenged in several Conference papers. More specific issues raised by the new evidence, and debated in the Conference, are the achievability of the ambient oxidant standard, the role of stratospheric ozone, the role of the natural ozone precursors, the utility of current air quality simulation models, and the significance of short- and long-range photochemical pollution transport. –

Cass, Glen R.,
Methods for sulfate air quality management with applications to Los Angeles, 2 vols.
Ph.D. Thesis. Pasadena, CA, California Institute of Technology, 1978.

Air pollution-particulate emissions-biomedical effects; Visibility; Air pollution-particulate emissions-control methods; SO_x-air pollution; *Sulfates-air pollution; Air pollution-mathematical models; Air pollution-emission inventories; California-air pollution; Light scattering;

Particulate sulfate air pollutants contribute to visibility deterioration and are of current public health concern. This study develops the technical understanding needed for sulfate air quality control strategy design. Methods which link sulfate air quality and air quality impacts on visibility to the cost of controlling sulfur oxides air pollutant emissions are presented. These techniques are tested by application to the Los Angeles Basin over the years 1972 through 1974.

Texas Air Control Board,
Microscopic analysis of suspended particulate matter.
Austin, TX, Aug. 1977.

*Texas-air pollution; Houston, TX-air pollution; Air pollution-particulate emissions-analysis; Air pollution-particulate emissions-standards and criteria; Air pollution-particulate emissions-sources; Air pollution-particulate emissions-meteorological factors;

The Texas State Implementation Plan, designed in part to attain these standards by May 31, 1975, was approved with exceptions on May 31, 1972 by the Environmental Protection Agency (EPA). Under the conditions of the FY-1976 federal grant from EPA to the Texas Air Control Board, analysis of all available data pertaining to the attainment status of the particulate standards in Texas has been conducted.

075505

MODELING ANALYSIS OF POWER PLANTS FOR EVALUATION OF IMPACT OF AMBIENT SO2 CONCENTRATIONS. METROPOLITAN HOUSTON-GALVESTON AQCR 216.

Abcor, Inc., Cambridge, Mass., Walden Research Div. (Editors)

Office of Air and Waste Management Contract, 32p., Feb. 1975. 3 refs.

1975

TECH Method of Support: CONTRACT

Diffusion modeling analyses of sulfur dioxide emissions from 10 thermal power plants located in the Metropolitan Houston-Galveston Air Quality Control Region (Texas) are presented as part of an effort to determine the air quality impact of such operations in the face of possible changes in fuel use and compliance schedule extensions. Emissions under both nominal and maximum load operations from each of the 10 plants result in contributions to ambient air concentrations which by themselves do not exceed the primary 24-hour and annual SO2 air quality standards. The ratio of the ambient SO2 concentration to the emission rate for a given plant in micrograms/cu m per g/sec ranges from 0.043-1.04 and 0.043-0.59 for nominal and maximum loads, respectively, on maximum concentration days and from 0.0048-0.13 for the maximum annual concentration. These values indicate the relative pollution potential for each plant which is primarily a function of stack design as well as surrounding terrain features.

Descriptors: AREA SURVEYS; ADMINISTRATION; AIR QUALITY MEASUREMENT PROGRAMS; PLANS AND PROGRAMS; CONTROL PROGRAMS; FUEL CRITERIA; CRITERIA; OPERATING CRITERIA; AIR QUALITY STANDARDS; STANDARDS; TEXAS; AMERICA; NORTH AMERICA; UNITED STATES; STACK GASES; POLLUTANTS; WASTE GASES; FUELS; SOURCES; STATIONARY EMISSION SOURCES; STEAM ELECTRIC POWER GENERATION; ELECTRIC POWER GENERATION; ELECTRIC, GAS, AND SANITARY SERVICES; INDUSTRIAL EMISSION SOURCES; DIFFUSION MODELS; ATMOSPHERIC PHENOMENA; DIFFUSION (ATMOSPHERIC); DISPERSION; SULFUR DIOXIDE; OXIDES; SULFUR OXIDES; CONTROL PROGRAMS

Identifiers: EMISSION FACTORS; COMPLIANCE SCHEDULES

Category: LEGAL AND ADMIN

Air Pollution Control Association, eds., Ozone/Oxidants--Interactions With The Total Environment, Proceedings of Specialty Conference, Dallas, Tx., March 1976. Air Pollution Control Assn., 1976.

006408

PERFORMANCE OF EXHAUST CONTROL DEVICES ON 1966 MODEL PASSENGER CARS.

W. F. McMichael, R. E. Kruse, D. M. Hill

J. Air Pollution Control Assoc., 18(4):246 -248, April 1968. 3 refs. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967, Paper 67-7.)

J AIR POLLUTION CONTROL ASSOC 1967

LAB Method of Support: INHOUSE

Road tests were carried out in five different cities with a fleet of 300 passenger cars consisting of three different makes, half of which were equipped with the 1966 exhaust control devices required by the State of California. The performance of these devices during the first series of tests was evaluated. In the first test series, mass emissions of hydrocarbons and carbon monoxide from equipped cars, were significantly lower than the 1962-1963 baseline emission values; except for the Chevrolets in the low-altitude cities, oxides of nitrogen levels from equipped cars were significantly higher than the baseline. Measurements of both mass emissions and concentratrations showed no consistent, significant differences among the three makes of equipped cars. All three makes of equipped cars showed the effects of enrichment due to altitude in Denver.##

Descriptors: ARIZONA; AMERICA; NORTH AMERICA; UNITED STATES; COLORADO; MINNESOTA; OHIO; CINCINNATI; TEXAS; HOUSTON; POLLUTANTS; ENGINE EMISSIONS; ENGINE EXHAUSTS; SOURCES; NON-INDUSTRIAL EMISSION SOURCES (STATIONARY); STATIONARY EMISSION SOURCES; MOTOR VEHICLE SOURCES; MOBILE EMISSION SOURCES; TRANSPORTATION METHODS; AUTOMOBILES; LIGHT-DUTY VEHICLES; CONTROL EQUIPMENT - GAS STREAMS; CONTROL METHODS; AUTOMOTIVE EMISSION CONTROL; ALTITUDE; ATMOSPHERIC PHENOMENA; HYDROCARBONS; OXIDES; CARBON MONOXIDE; NITROGEN OXIDES; ARIZONA; COLORADO; MINNESOTA

Identifiers: PHOENIX; DENVER; MINNEAPOLIS

Category: CONTROL METHODS

Houston, City of, Texas, Health Department, Air Pollution Control Program,
1975 Annual Statistical Report, Air Pollution Control Program.
Houston, Tx., undated.

Houston, TX-air pollution;

Houston, City of, Texas, Health Department,
Petition for review and revision of ambient air quality standard for photochemical oxidants and requirements for control.
Houston, TX, July 1977.

Houston, TX-air pollution; *Photochemical pollutants-standards; Photochemical pollutants-monitoring; Photochemical pollutants-control strategies; Haze; Ozone-reactions; Hydrocarbons-analysis; Hydrocarbons-regulations; Hydrocarbons-oxidation; Air pollution-health effects; Automobile emissions-air pollution; Air pollution-biological effects; Air pollution-control methods;

043008
POLLUTION CONTROL IN HARRIS COUNTY, TEXAS.
Quebedeaux, W. A.
Oklahoma Eng. Exp. Sta. Publ., no. 97, 23(1):63-73, Dec. 1955.
OKLAHOMA ENG EXP STA PUBL 1955
TECH Method of Support: NONE

Instead of setting definite limits on the concentration of noxious contaminants in industrial stacks, Harris County decided to allow only that amount which did not materially affect the residents in close proximity to a given plant. To promote air-pollution abatement, the Texas State Health Department and the Harris County Health Unit evolved a program including open hearings, meetings with industrial committees of the Houston Chamber of Commerce, and conferences between health department personnel and representatives of industries producing considerable pollution. By cooperation with industry and interested citizen groups, much of the industrial air pollution was eliminated by the end of 1953. In 1954. laboratory facilities were enlarged so that all air and water samples collected could be handled and personnel combined for better organization. Financial aid was given to the plan on a per capita basis by 17 municipalities in Harris County. Some specific conditions which have been remedied by actions of the Stream and Air Pollution Control Section and/or with the co peravtive efforts of the plants responsible are listed. Incidences of legal prosecution, including civil and penal cases are summarized.

Descriptors: PLANS AND PROGRAMS; ADMINISTRATION; CONTROL AGENCIES; TEXAS; AMERICA; NORTH AMERICA: UNITED STATES: HOUSTON; INDUSTRIAL EMISSION SOURCES; SOURCES: STATIONARY EMISSION SOURCES; WATER POLLUTION; NON-INDUSTRIAL EMISSION SOURCES (NEC): WATER BODIES
Category: LEGAL AND ADMIN

Houston, City of, Chamber of Commerce,
Program description of the Houston area oxidants study (The HAOS Blue Book).
Houston, Tx., June 1976.

Houston, Tx., Texas-air pollution; photochemical pollutants; *Air pollution-social and environmental effects;

This document is the Program Description of the Houston Area Oxidants Study (referred to as the HAOS "Blue Book"). It presents a discussion of the program that the Houston Chamber of Commerce, its associated members, and some citizens of Southeast Texas are sponsoring to evaluate the impact of the airborne photochemical oxidants (and haze) on the social, economic and environmental communities in the Houston area. The sponsors recognize that Houston's projected economic growth could affect its air quality; however, the extent of this effect is unknown. To quantify the unknown, several projects, having both socio-economic and environmental aspects, have been grouped into an overall study (the Houston Area Oxidants Study).

052474
PROPOSED APPROVAL AND PROMULGATION OF STATE IMPLEMENTATION PLANS. NEW JERSEY, PENNSYLVANIA, TEXAS.
Fri, Robert W.
Federal Register, 38(127): 17782-17811, July 3, 1973.
FEDERAL REGISTER 1973
TECH Method of Support: INHOUSE

New Jersey, Pennsylvania, and Texas state implementation plans of the national ambient air quality standards are presented. Pollution in the New Jersey portions of the New Jersey-New York- Connecticut region and the Philadelphia metropolitan region are reviewed, along with control methodology, current studies, proposed controls on stationary and mobile sources, and the economic and social impact of the New Jersey transportation control plan. A compilation of control strategy effects is presented: and daylight delivery ban regulations, a motorcycle limitation program, gas limitation regulations, the control of dry cleaning solvent evaporation, storage of petroleum products, paint and varnish operations, and Federal compliance schedules are discussed. The Pennsylvania implementation plan is presented. Transportation control alternatives, additional control strategies, control of mobile sources, implementation procedures, the economic and social impact, direct costs to automobile owners, tax revenue implications, and various studies and guidelines are reviewed. The Texas implementation program is presented, along with various control strategies for stationary and mobile sources in the areas of Houston-Galveston, Austin, Dallas-Fort Worth, San Antonio, and El Paso. The socio-economic impact and efforts to mitigate the effects of proposed regulations are reviewed.

Descriptors: PLANS AND PROGRAMS; ADMINISTRATION; CONTROL PROGRAMS; COSTS; ECONOMICS; NATIONAL GOVERNMENTS; GOVERNMENTS; STATE GOVERNMENTS; REGULATIONS; LEGAL ASPECTS; SOCIO-ECONOMIC FACTORS; AIR QUALITY STANDARDS; STANDARDS; COMPLIANCE (RESPIRATORY); BIOLOGICAL PROCESSES AND FUNCTIONS; RESPIRATORY FUNCTIONS; NEW JERSEY; AMERICA; NORTH AMERICA; UNITED STATES; PENNSYLVANIA; TEXAS; INDUSTRIAL EMISSION SOURCES; SOURCES; STATIONARY EMISSION SOURCES; DRY CLEANING PLANTS (EXCEPT RUG); SERVICE INDUSTRIES; PETROLEUM DISTRIBUTION; SURFACE COATING OPERATIONS; TRANSPORTATION METHODS; MOBILE EMISSION SOURCES; PLANS AND PROGRAMS
Identifiers: IMPLEMENTATION PLANS
Category: LEGAL AND ADMIN

079189
PUBLIC ATTIDUTE SURVEY ON AUTO AIR POLLUTION IN THE GREATER HOUSTON AREA.
Subcommittee on Environmental Pollution (Editors)
In: Implementation of Transportation Controls. 93rd Congress (Senate), Second Session, Serial 93-H29, p. 98-113, May 1 and 2, 1974. (Hearings before the Committee on Public Works.)
1974
FLD Method of Support: NONE

The results of a survey of public opinion in the Houston area regarding air pollution are presented. More than 93% of the respondents felt that air pollution was a problem in the area. Some 71% of 163 households questioned indicated that they favored a retrofit program costing about $50.00; only 35%

supported a retrofit program costing $200.00. An inspection/maintenance program was favored by 82% of the respondents. Reaction to all types of travel restrictive controls was strongly negative. Response to transit related questions generally indicated the area's current low reliance on public transit. About 37% of the respondents indicated an interest in car pooling for work commute trips. An additional 9.5% were currently car-pooling. Staggered work hours were favored by 71% of the respondents as a means of reducing congestion and pollution. Only 7.5% of the respondents were willing to consider disposal of a family car if better public transit service were available.

Descriptors: RETROFIT PROGRAMS; ADMINISTRATION; CONTROL PROGRAMS; PLANS AND PROGRAMS; TRANSPORTATION CONTROL PLANS; COSTS; ECONOMICS; OPINION SURVEYS; PUBLIC AFFAIRS; SOCIO-ECONOMIC FACTORS; ENGINE EXHAUSTS; ENGINE EMISSIONS; POLLUTANTS; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; INSPECTION; CONTROL METHODS; MAINTENANCE; AUTOMOBILES; LIGHT-DUTY VEHICLES; MOBILE EMISSION SOURCES; MOTOR VEHICLE SOURCES; SOURCES; TRANSPORTATION METHODS

Category: SOCIAL ASPECTS

Gise, James P.,
"Recent ozone trends in Texas,"
Presented at the 83rd AIChE National Meeting, Houston, March 1977.

University of Texas at Austin, Atmospheric Science Group,
Scientific Report Series. Report Nos. 6, 15, 16, 18, 19, 22, 23, 24, 29, 35, 36, 37, 38, 40 and 48 are meteorological studies pertaining to the Texas Gulf Coast.
Austin, TX, various dates.

040913
SIMULATION OF ECOLOGICAL SYSTEMS.
Eddy, Amos
Preprint, American Meteorological Society, Boston, Mass., 12p., 1971. 4 refs. (Presented at the American Meteorology Society Meeting, 51st, San Francisco, Calif., Jan. 11-14, 1971.)
AM METEOROL SOC MEET 51ST SAN FRANCISCO CALIF 1971 1971
THEO Method of Support: NONE

A computer simulation model representing a mesoscale ecosystem was designed to study the evolution of an ecosystem of a period of 25 yr. Interest centers on the statistical properties of a field of variables. Interaction between variables is primarily governed by conditional probabilities. Some deterministic components are used but they are controlled by the environment in which they are imbedded. The environment modeled is the Houston-Dallas-San Antonio ecosystem. The variety of possible futures which can evolve from particular sets of management policies is demonstrated.

The system is structured with submodels for atmospheric and hydrologic behavior, population dynamics, and decision making routines. A clear application of the model is to provide optimal resource management practices.
Descriptors: PLANS AND PROGRAMS; ADMINISTRATION; AIR RESOURCE MANAGEMENT; URBAN AREAS; METROPOLITAN AREAS; COMPUTERS; SIMULATION
Category: LEGAL AND ADMIN

Worth, James J. B. and Robert E. Neligan, The Sources and Long Distance Transport of Ozone, Research Triangle Park, N.C., Research Triangle Inst.

Texas Air Control Board,
Status of major compliance programs in the Brownsville-Laredo, Corpus Christi, Houston/Galveston, Dallas, San Antonio/Eagle Pass, and El Paso air quality control regions.
Austin, TX, Dec. 1976.

Air pollution-particulate emissions-standards and criteria; *Texas-air pollution; Air pollution-air quality maintenance plans; Air pollution-implementation plans; Houston, Texas-air pollution;

078337
TEXAS: STATUS OF OXIDANT CONTROL STRATEGY PLAN.
Strelow, Roger
Federal Register, 40(57):13025-13026, March 24, 1975.
FEDERAL REGISTER 1975
TECH Method of Support: INHOUSE
The status of various regulations for attainment of the primary standard for photochemical oxidants in Texas is discussed. The U. S. Circuit Court of Appeals required that the Environmental Protection Agency defer regulations in the Houston-Galveston Region that account for at least 0.9% reductions in hydrocarbon emissions because of questions concerning emission data. The Court pointed out that the 0.9% could be supplied, for the time being, by deferral of a regulation on stage II vapor recovery, because the Court required the Agency to reconsider that regulation for other reasons. The EPA has taken no steps to enforce the regulation. The Court stated that, unless the Agency decided to defer one of them in place of the stage II vapor recovery regulation, regulations on degreasing operations, state I vapor recovery during the filling of storage tanks, ship and barge controls, vehicle inspection and maintenance, and retrofit of pre-1968 automobiles are valid and enforceable for the Houston-Galveston Air Quality Control Region. Motions for rehearing on ship and barge controls were denied. Shortly after the decision, the Environmental Protection Agency and the Texas Air Control Board began a joint study that will satisfy the requirement of the court to reexamine the accuracy of certain technical data relating to emission reductions and the consequent need for various emission reduction regulations. The study suggests the need for additional

controls in most regions if the oxidant standard is to be met.

Descriptors: DECISIONS; LEGAL ASPECTS; HYDROCARBONS; PHOTOOXIDATION; CHEMICAL AND PHYSICAL PHENOMENA; CHEMICAL REACTIONS; PHOTOCHEMICAL REACTIONS; VAPORS; PHYSICAL STATES; REGULATIONS; STANDARDS; OXIDANTS; POLLUTANTS; HOUSTON; AMERICA ; NORTH AMERICA; TEXAS; UNITED STATES; VAPOR RECOVERY SYSTEMS; CONTROL EQUIPMENT-GAS STREAMS; AUTOMOTIVE EMISSION CONTROL; CONTROL METHODS; INSPECTION; MAINTENANCE; AUTOMOBILES; LIGHT-DUTY VEHICLES; MOBILE EMISSION SOURCES; MOTOR VEHICLE SOURCES; SOURCES; TRANSPORTATION METHODS; VESSELS (MARINE); DEGREASING; STATIONARY EMISSION SOURCES; STORAGE FACILITIES (BULK LIQUID); INDUSTRIAL EMISSION SOURCES

Category: LEGAL AND ADMIN

060756

TRANSPORTATION CONTROL STRATEGY DEVELOPMENT FOR THE GREATER HOUSTON AREA. (FINAL REPORT).

TRW Transportation and Environmental Operations, Redondo Beach, Calif., Land Use Planning Branch (Editors)

Office of Air Quality Planning and Standards Contract 68-02-0041, Proj. DU-72-B695, Rept. APTD-1373, 188p., Dec. 1972. 50 refs.

1972

THEO BIB Method of Support: CONTRACT

Control measures are presented that, if fully implemented, will allow achievement of ambient air quality standards in the Greater Houston Area by 1977; the measures pertain to control of photochemical oxidants and carbon monoxide. Phase I measures include: continued evaluation of control measures with expansion of the air monitoring program and initiation of a regular review of air quality and emission inventory data; tightening and expanding of the Regulation V stationary source controls with inclusion of all counties in the region; implementation of an annual inspection/maintenance program for in-use vehicles; substantial improvement in mass transit; institution of parking measures in all high density areas; initiation of car pool incentives; and promulgation of regulations to control fugitive and evaporative hydrocarbon emissions. Implementation of catalytic converter retrofit on all 1968-1974 automobiles and/or reduction in the vehicle miles traveled during the summer and fall is recommended if at the end of the initial evaluation period in 1974 it is determined that additional hydrocarbon emission reductions are required.

Descriptors: AREA SURVEYS; ADMINISTRATION; AIR QUALITY MEASUREMENT PROGRAMS; PLANS AND PROGRAMS; AIR RESOURCE MANAGEMENT; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES; URBAN AREAS; METROPOLITAN AREAS; FUEL EVAPORATION; ENGINE EMISSIONS; POLLUTANTS; OXIDANTS; MASS TRANSPORTATION; MOBILE EMISSION SOURCES; SOURCES; TRANSPORTATION METHODS; AUTOMOBILES; LIGHT-DUTY VEHICLES; MOTOR VEHICLE SOURCES; MONITORING; MEASUREMENT METHODS; CATALYTIC AFTERBURNERS; CONTROL EQUIPMENT-GAS STREAMS; INCINERATORS (WASTE GASES); CONTROL METHODS; AUTOMOTIVE EMISSION CONTROL; INSPECTION; MAINTENANCE; CARBON MONOXIDE; OXIDES; HYDROCARBONS

Category: CONTROL METHODS

050629

TRANSPORTATION CONTROLS TO REDUCE MOTOR VEHICLE EMISSIONS IN MAJOR METROPOLITAN AREAS.

GCA Corp., Bedford, Mass., Technology Div. and TRW Systems Group, McLean, Va., Transportation and Environmental Operations (Editors)

Office of Air and Water Programs Contract 68-02-0041 and Contract 68-02-0048, Pub-APTD-1462, Proj. DU-72-B895, 137p., Dec. 1972. 7 refs.

1972

THEO FLD Method of Support: CONTRACT

USGRDR No.: NTIS, PB 218938

Transportation control strategies to reduce motor vehicle emissions in fourteen major metropolitan areas were studied. Implementation plans were reviewed to verify and assess the severity of the carbon monoxide and oxidant pollutant problem.

Control strategies were identified and their impact on emissions, as well as the feasibility of achieving control was considered. The likely impact anticipated from each of the control techniques was estimated using established rollback or modeling methods; obstacles to the implementation programs were documented; and surveillance programs to monitor implementation progress were developed. The fourteen areas studied included Dayton, Denver, Houston/Galveston, Los Angeles, New York City, Philadelphia, Phoenix/Tucson, Baltimore, Boston, Pittsburgh, Salt Lake City, Spokane, Seattle, Minneapolis/St. Paul. The air quality problems encountered in each of these areas are discussed, and the recommended strategies for each city are given. Strategies include inspection, maintenance, gaseous fuel use, engine operation modifications, traffic flow improvements, and mass transit.

Descriptors: PLANS AND PROGRAMS; ADMINISTRATION; CONTROL PROGRAMS; FEASIBILITY STUDIES; AIR QUALITY STANDARDS; STANDARDS; EMISSION STANDARDS; PERFORMANCE STANDARDS; ARIZONA; AMERICA; NORTH AMERICA; UNITED STATES; LOS ANGELES; CALIFORNIA ; COLORADO; MARYLAND; MASSACHUSETTS; MINNESOTA; NEW YORK CITY; NEW YORK STATE; OHIO; PHILADELPHIA; PENNSYLVANIA; PITTSBURGH; HOUSTON; TEXAS; UTAH; WASHINGTON (STATE); URBAN AREAS; METROPOLITAN AREAS; ENGINE EMISSIONS; POLLUTANTS; OXIDANTS; FUEL GASES; FUELS; SOURCES; STATIONARY EMISSION SOURCES; TRANSPORTATION METHODS; MOBILE EMISSION SOURCES; MASS TRANSPORTATION; MOTOR VEHICLE SOURCES; MONITORING; MEASUREMENT METHODS; AUTOMOTIVE EMISSION CONTROL; CONTROL METHODS; ENGINE OPERATION MODIFICATION; INSPECTION; MAINTENANCE; MATHEMATICAL ANALYSES; CARBON MONOXIDE; OXIDES; ARIZONA; COLORADO; MARYLAND ; MASSACHUSETTS; MINNESOTA; OHIO; PLANS AND PROGRAMS; UTAH; WASHINGTON (STATE)

Identifiers: PHOENIX; DENVER; BALTIMORE; BOSTON; MINNEAPOLIS ; DAYTON; IMPLEMENTATION PLANS; SALT LAKE CITY; SEATTLE; SPOKANE

Category: LEGAL AND ADMIN

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ID NO.- MGA23050169
Use of statistical techniques to assesses progress toward a clean air environment: Houston, Texas.
Severs, R. K.
School of Public Health, Univ. of Tex., Houston
Atmospheric Environment, Oxford, 5(10):853-861, Oct. 1971.
CTRY OF PUBL:UK
DOC TYPE: j
DESCRIPTORS: Atmospheric pollution control studies; Houston, Texas
UCD NOT:551.510.42:628.5

039888
WE DON T HAVE ALL THE ANSWERS.
Air Repair, 2(2):52-58, Nov. 1952.
AIR REPAIR 1952
GEN Method of Support: NONE
Efforts by industry to reduce air pollution in Harris County, Tex., especially in the Ship Channel area, are cited by industry representatives at a public hearing in Houston in excerpts from their testimony. Statements by local officials are also given. Specific problems discussed include odors and fly ash from a pulp mill, dust and odors from a chemical plant, dusts and smoke from a fertilizer plant, odors from an alkali plant, and refinery emissions.
Descriptors: ABATEMENT; COMMERCIAL FIRMS; HEARINGS; LEGAL ASPECTS; HOUSTON; AMERICA; NORTH AMERICA; TEXAS; UNITED STATES ; URBAN AREAS; METROPOLITAN AREAS; PARTICULATE CLASSIFICATION METHODS; POLLUTANTS; DUSTS; PARTICULATES; SETTLING PARTICLES; FLY ASH; SUSPENDED PARTICULATES; SMOKES; CHEMICAL PROCESSES; INDUSTRIAL EMISSION SOURCES; SOURCES; STATIONARY EMISSION SOURCES; PETROLEUM REFINING; MANUFACTURING INDUSTRIES; PETROLEUM AND COAL PRODUCTS INDUSTRY; AGRICULTURAL CHEMICAL PLANTS; CHEMICALS AND ALLIED MANUFACTURING; PAPER MILLS; PAPER AND ALLIED MANUFACTURING
Category: CONTROL METHODS

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APPENDIX A

SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES IN THE HOUSTON AREA

TABLE A-1. SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)

DATE 032976 PAGE 8

SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR) REGION: 7 COUNTY: BRAZORIA YEAR: 1975

CATEGORY	NOX	SOX	HC	CO	PA	INPUT PARAMETERS		VALUES
RESDNTL FUEL-GAS	134	1	13	34	27	POPULATION	:	128500
RESDNTL FUEL-DISTLT OIL	8	23	2	3	6	POPULATION		
RESDNTL FUEL-WOOD	11	0	23	287	98	POPULATION		
RESDNTL FUEL-ALL	154	23	38	324	131			
COMM-IND FUEL-GAS	100	1	6	16	12	POPLTN//GALS LPG(FARM)	:	128500// 263000
COMM-IND FUEL-OIL	40	130	8	13	31	POPULATION		
COMM-IND FUEL-ALL	141	130	15	29	43			
SUBTOTAL-EXTRNL COMBSTN	294	154	53	354	174			
IRRGTN PUMPS-GAS	7	0	0	1	0	IRRIGATED LAND (ACRES)	:	1000
TOTAL-FUEL COMBUSTION	301	154	53	355	174			
COMM-IND INCINERATION	3	2	4	11	7	POPULATION		
TOTAL-SOLID WASTE DSPSL	3	2	4	11	7			
LIGHT DUTY VEHCLS-GSLN	4351	122	4975	20786	448	VMT(U/R)//SPEED(U/R)	:	323MLN/ 460MLN//35/50MPH
HEAVY DUTY VEHCLS-GSLN	535	15	785	3415	50	VMT(U/R)//SPEED(U/R)	:	9MLN/ 29MLN//35/50MPH
MOTORCYCLES-GSLN	4	0	152	539	3	MOTORCYCLES REGISTERED	:	1993
OFF HIGHWAY-GSLN	83	4	194	2932	5	GAL FUEL(FARM//OTHER)	:	446000// 545000
GSLN TRANSPRTN-TOTAL	4973	141	6105	27671	506			
HEAVY TRUCKS-DIESEL	1353	138	124	393	103	VMT/(U/R)//SPEED(U/R)	:	5MLN/ 40MLN//35/50MPH
OFF HIGHWAY-DIESEL	879	74	120	274	91	GAL FUEL(FARM//OTHER	:	2540000// 2152000
RAIL-DIESEL	396	62	101	139	27	THSNDS OF GALS FUEL USED	:	2140
DIESEL TRANSPRTN-TOTAL	2628	274	344	806	221			
SUBTOTAL-LAND TRANSPRTN	7601	415	6449	28477	727			
CIVIL AIRCRAFT	7	0	9	277	0	LANDINGS/TAKEOFFS	:	93800
VESSELS-DIESEL	527	138	98	215	49	TON-MI(MLN)//DOCKD SHIPS	:	686// 250
VESSELS-RESIDUAL FUEL	20	223	10	0	6	TON-MI(MLN)//DOCKD SHIPS	:	10// 9
VESSELS-GASOLINE (BOATS)	1	1	211	616	0	LAKE/BAY AREA (ACRES)	:	12833
SUBTOTAL-VESSELS	548	163	319	831	54			
FUEL HANDLING EVAPRTN	0	0	682	0	0	THSNDS OF GALS FUEL USED	:	78000
TOTAL-TRANSPORTATION	8157	778	7459	29586	782			
SOLVENT EVAPRTN LOSS	0	0	198	0	0	POPULATION	:	128500
STRUCTURAL FIRES	1	0	1	14	5	POPULATION		
AGRICULTURAL TILLING	0	0	0	0	904	ACRES//SILT//PE INDEX	:	89000//.40//83
UNPAVED ROADS	0	0	0	0	325	MI(U/R)//SILT//WET DAYS	:	99/ 497//.40//65
REENTRNMNT-PAVED ROADS	0	0	0	0	429	VMT ON PAVEMENT (MLN)	:	857
TOTAL-MISCELLANEOUS	1	0	199	14	1663			
GRAND TOTAL-AREA SOURCES	8461	934	7716	29966	2626			

TABLE A-2. SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)

DATE 032976 PAGE 13

SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR) REGION: 7 COUNTY: CHAMBERS YEAR: 1975

CATEGORY	NOX	SOX	HC	CO	PA	INPUT PARAMETERS	VALUES
RESDNTL FUEL-GAS	14	0	1	3	3	POPULATION :	13100
RESDNTL FUEL-DISTLT OIL	1	2	0	0	1	POPULATION	
RESDNTL FUEL-WOOD	1	0	2	29	10	POPULATION	
RESDNTL FUEL-ALL	16	2	4	33	13		
COMM-IND FUEL-GAS	13	0	1	2	1	POPLTN//GALS LPG(FARM) :	13100// 105000
COMM-IND FUEL-OIL	4	13	1	1	3	POPULATION	
COMM-IND FUEL-ALL	17	13	2	3	4		
TOTAL-FUEL COMBUSTION	33	16	5	36	18		
RESDNTL OPEN BURNING	6	1	29	84	16	POPULATION//OPN BRN FCTR:	13100// 100
COMM-IND OPEN BURNING	2	0	12	33	6	POPULATION//OPN BRN FCTR	
COMM-IND INCINERATION	0	0	0	1	1	POPULATION	
TOTAL-SOLID WASTE DSPSL	9	2	42	118	23		
LIGHT DUTY VEHCLS-GSLN	1647	48	1718	6089	165	VMT(U/R)//SPEED(U/R) :	18MLN/ 282MLN//35/50MPH
HEAVY DUTY VEHCLS-GSLN	329	8	357	1599	28	VMT(U/R)//SPEED(U/R) :	1MLN/ 20MLN//35/50MPH
MOTORCYCLES-GSLN	0	0	12	44	0	MOTORCYCLES REGISTERED :	323
OFF HIGHWAY-GSLN	81	3	109	2176	4	GAL FUEL(FARM//OTHER) :	357000// 792000
GSLN TRANSPRTN-TOTAL	2058	59	2196	9907	197		
HEAVY TRUCKS-DIESEL	399	40	35	108	30	VMT/(U/R)//SPEED(U/R) :	0MLN/ 13MLN//35/50MPH
OFF HIGHWAY-DIESEL	982	80	121	292	92	GAL FUEL(FARM//OTHER :	2000000// 3124000
RAIL-DIESEL	300	47	76	105	20	THSNDS OF GALS FUEL USED:	1620
DIESEL TRANSPRTN-TOTAL	1680	168	232	505	142		
SUBTOTAL-LAND TRANSPRTN	3738	227	2429	10412	339		
CIVIL AIRCRAFT	2	0	3	104	0	LANDINGS/TAKEOFFS :	34300
VESSELS-DIESEL	415	109	77	168	38	TON-MI(MLN)//DOCKD SHIPS:	706// 0
VESSELS-RESIDUAL FUEL	40	293	0	3	15	TON-MI(MLN)//DOCKD SHIPS:	366// 0
VESSELS-GASOLINE (BOATS)	4	4	654	1911	0	LAKE/BAY AREA (ACRES) :	41300
SUBTOTAL-VESSELS	459	406	731	2082	53		
FUEL HANDLING EVAPRTN	0	0	293	0	0	THSNDS OF GALS FUEL USED:	30700
TOTAL-TRANSPORTATION	4199	633	3455	12597	392		
SOLVENT EVAPRTN LOSS	0	0	20	0	0	POPULATION :	13100
STRUCTURAL FIRES	0	0	0	1	0	POPULATION	
FOREST FIRES	2	0	10	63	7	FORESTED LAND (ACRES) :	35000
AGRICULTURAL TILLING	0	0	0	0	589	ACRES//SILT//PE INDEX :	58000//.40//83
UNPAVED ROADS	0	0	0	0	48	MI(U/R)//SILT//WET DAYS :	67 103//.40//56
REENTRNMNT-PAVED ROADS	0	0	0	0	167	VMT ON PAVEMENT (MLN) :	333
TOTAL-MISCELLANEOUS	2	0	31	64	811		
GRAND TOTAL-AREA SOURCES	4242	650	3533	12816	1244		

TABLE A-3. SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)

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                                                                                          DATE 032976        PAGE    24

        SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)              REGION: 7    COUNTY: FORT BEND          YEAR: 1975

        CATEGORY                 NOX       SOX        HC        CO        PA     INPUT PARAMETERS         VALUES
----------------------------------------------------------------------------------------------------------------------------
RESDNTL FUEL-GAS                  66         0         7        17        13     POPULATION             :  62700
RESDNTL FUEL-DISTLT OIL            4        11         1         2         3     POPULATION
RESDNTL FUEL-WOOD                  6         0        11       140        48     POPULATION
RESDNTL FUEL-ALL                  75        11        19       158        64

COMM-IND FUEL-GAS                 50         0         3         8         6     POPLTN//GALS LPG(FARM) :   62700//  175000
COMM-IND FUEL-OIL                 20        63         4         7        15     POPULATION
COMM-IND FUEL-ALL                 70        64         7        14        21

SUBTOTAL-EXTRNL COMBSTN          145        75        26       173        85

IRRGTN PUMPS-GAS                  26         0         0         4         0     IRRIGATED LAND (ACRES) :    4000
IRRGTN PUMPS-GASOLINE              0         0         0         3         0     IRRIGATED LAND
SUBTOTAL-INTRNL COMBSTN           27         0         0         6         0

TOTAL-FUEL COMBUSTION            172        75        26       179        85

COMM-IND INCINERATION              1         1         2         5         4     POPULATION
TOTAL-SOLID WASTE DSPSL            1         1         2         5         4

LIGHT DUTY VEHCLS-GSLN          3194        90      3527     14615       329     VMT(U/R)//SPEED(U/R)   :  229MLN/ 352MLN//35/50MPH
HEAVY DUTY VEHCLS-GSLN           354        10       558      2359        34     VMT(U/R)//SPEED(U/R)   :    6MLN/  20MLN//35/50MPH
MOTORCYCLES-GSLN                   2         0        64       228         1     MOTORCYCLES REGISTERED :    1686
OFF HIGHWAY-GSLN                  50         2       112      1690         3     GAL FUEL(FARM//OTHER)  :  342000//  266000
GSLN TRANSPRTN-TOTAL            3599       103      4261     18892       367

HEAVY TRUCKS-DIESEL              762        78        70       220        58     VMT/(U/R)//SPEED(U/R)  :    3MLN/  22MLN//35/50MPH
OFF HIGHWAY-DIESEL               551        47        81       177        61     GAL FUEL(FARM//OTHER   : 1939000// 1050000
RAIL-DIESEL                      468        73       119       164        32     THSNDS OF GALS FUEL USED:   2530
DIESEL TRANSPRTN-TOTAL          1781       198       269       562       151

SUBTOTAL-LAND TRANSPRTN         5380       301      4530     19454       518

CIVIL AIRCRAFT                     1         0         1        59         0     LANDINGS/TAKEOFFS      :   19500

VESSELS-GASOLINE (BOATS)           1         1       154       451         0     LAKE/BAY AREA (ACRES)  :    9365

FUEL HANDLING EVAPRTN              0         0       503         0         0     THSNDS OF GALS FUEL USED:  55500

TOTAL-TRANSPORTATION            5382       302      5189     19965       518

SOLVENT EVAPRTN LOSS               0         0        97         0         0     POPULATION             :   62700
STRUCTURAL FIRES                   0         0         1         7         2     POPULATION
AGRICULTURAL TILLING               0         0         0         0      2189     ACRES//SILT//PE INDEX  :  139000//.62//83
UNPAVED ROADS                      0         0         0         0       310     MI(U/R)//SILT//WET DAYS :   60/ 604//.62//64
REENTRNMNT-PAVED ROADS             0         0         0         0       312     VMT ON PAVEMENT (MLN)  :     623
TOTAL-MISCELLANEOUS                0         0        97         7      2813

GRAND TOTAL-AREA SOURCES        5555       378      5315     20155      3420
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TABLE A-4. SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)

DATE 032976 PAGE 28

SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR) REGION: 7 COUNTY: GALVESTON YEAR: 1975

CATEGORY	NOX	SOX	HC	CO	PA	INPUT PARAMETERS	VALUES
RESDNTL FUEL-GAS	200	1	20	51	40	POPULATION	191600
RESDNTL FUEL-DISTLT OIL	11	34	3	5	10	POPULATION	
RESDNTL FUEL-WOOD	17	0	34	428	145	POPULATION	
RESDNTL FUEL-ALL	229	35	57	483	195		
COMM-IND FUEL-GAS	143	1	10	24	18	POPLTN//GALS LPG(FARM)	191600// 35000
COMM-IND FUEL-OIL	60	194	12	20	46	POPULATION	
COMM-IND FUEL-ALL	203	194	22	44	64		
TOTAL-FUEL COMBUSTION	432	229	79	527	259		
COMM-IND INCINERATION	4	4	6	16	11	POPULATION	
TOTAL-SOLID WASTE DSPSL	4	4	6	16	11		
LIGHT DUTY VEHCLS-GSLN	5065	146	6279	30269	541	VMT(U/R)//SPEED(U/R)	742MLN/ 216MLN//35/50MPH
HEAVY DUTY VEHCLS-GSLN	467	14	757	3576	46	VMT(U/R)//SPEED(U/R)	21MLN/ 14MLN//35/50MPH
MOTORCYCLES-GSLN	4	0	168	596	3	MOTORCYCLES REGISTERED	4413
OFF HIGHWAY-GSLN	66	4	193	2831	5	GAL FUEL(FARM//OTHER)	44000// 665000
GSLN TRANSPRTN-TOTAL	5602	165	7397	37271	596		
HEAVY TRUCKS-DIESEL	990	103	97	343	77	VMT/(U/R)//SPEED(U/R)	13MLN/ 21MLN//35/50MPH
OFF HIGHWAY-DIESEL	577	45	56	157	43	GAL FUEL(FARM//OTHER	256000// 2626000
RAIL-DIESEL	679	106	173	239	46	THSNDS OF GALS FUEL USED	3670
DIESEL TRANSPRTN-TOTAL	2247	254	326	738	166		
SUBTOTAL-LAND TRANSPRTN	7849	418	7722	38010	761		
CIVIL AIRCRAFT	8	0	11	337	0	LANDINGS/TAKEOFFS	100700
VESSELS-DIESEL	1702	448	315	692	158	TON-MI(MLN)//DOCKD SHIPS	2426// 810
VESSELS-RESIDUAL FUEL	185	1681	53	7	61	TON-MI(MLN)//DOCKD SHIPS	934// 0
VESSELS-GASOLINE (BOATS)	4	4	645	1886	0	LAKE/BAY AREA (ACRES)	40000
SUBTOTAL-VESSELS	1891	2132	1014	2585	219		
FUEL HANDLING EVAPRTN	0	0	737	0	0	THSNDS OF GALS FUEL USED	87300
TOTAL-TRANSPORTATION	9748	2551	9484	40931	980		
SOLVENT EVAPRTN LOSS	0	0	296	0	0	POPULATION	191600
STRUCTURAL FIRES	1	0	2	21	7	POPULATION	
AGRICULTURAL TILLING	0	0	0	0	81	ACRES//SILT//PE INDEX	8000//.40//83
UNPAVED ROADS	0	0	0	0	319	MI(U/R)//SILT//WET DAYS	148/ 252//.40//54
REENTRNMNT-PAVED ROADS	0	0	0	0	509	VMT ON PAVEMENT (MLN)	1017
TOTAL-MISCELLANEOUS	1	0	297	21	916		
GRAND TOTAL-AREA SOURCES	10186	2784	9867	41495	2167		

TABLE A-5. SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)

DATE 042878 PAGE 41

SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR) REGION: 7 COUNTY: HARRIS YEAR: 1976

CATEGORY	NOX	SOX	HC	CO	PA	INPUT PARAMETERS	VALUES
RESDNTL FUEL-GAS	2293	13	230	579	458	POPULATION	: 2192600
RESDNTL FUEL-DISTLT OIL	132	386	33	57	110	POPULATION	
RESDNTL FUEL-WOOD	195	0	390	4894	1664	POPULATION	
RESDNTL FUEL-ALL	2620	399	653	5530	2232		
COMM-IND FUEL-GAS	1637	9	110	272	204	POPLTN//GALS LPG(FARM)	: 2192600// 281000
COMM-IND FUEL-OIL	688	2217	143	230	531	POPULATION	
COMM-IND FUEL-ALL	2326	2225	252	502	735		
TOTAL-FUEL COMBUSTION	4946	2625	906	6032	2967		
COMM-IND INCINERATION	48	42	68	182	127	POPULATION	
TOTAL-SOLID WASTE DSPSL	48	42	68	182	127		
LIGHT DUTY VEHCLS-GSLN	59104	1778	69278	334576	5961	VMT(U/R)//SPEED(U/R)	: 9549MLN/2189MLN//35/40MPH
HEAVY DUTY VEHCLS-GSLN	4317	119	5746	31458	399	VMT(U/R)//SPEED(U/R)	: 198MLN/ 101MLN//35/40MPH
MOTORCYCLES-GSLN	51	6	2174	7725	40	MOTORCYCLES REGISTERED	: 57219
OFF HIGHWAY-GSLN	680	44	2119	30385	56	GAL FUEL(FARM//OTHER)	: 342000// 6622000
GSLN TRANSPRTN-TOTAL	64153	1947	79318	404144	6456		
HEAVY TRUCKS-DIESEL	11653	1235	1257	5002	926	VMT/(U/R)//SPEED(U/R)	: 177MLN/ 224MLN//35/40MPH
OFF HIGHWAY-DIESEL	5642	436	541	1522	415	GAL FUEL(FARM//OTHER	: 1972000//26122000
RAIL-DIESEL	2510	393	638	882	170	THSNDS OF GALS FUEL USED:	13570
DIESEL TRANSPRTN-TOTAL	19805	2065	2436	7405	1511		
SUBTOTAL-LAND TRANSPRTN	83958	4012	81754	411549	7967		
MILITARY AIRCRAFT	611	48	764	2907	62	LANDINGS/TAKEOFFS	: 167600
CIVIL AIRCRAFT	74	4	92	2425	6	LANDINGS/TAKEOFFS	: 787500
COMMERCIAL ACFT	789	114	987	2377	66	LANDINGS/TAKEOFFS	: 170700
SUBTOTAL-AVIATION	1474	166	1843	7709	134		
VESSELS-DIESEL	1206	317	224	490	112	TON-MI(MLN)//DOCKD SHIPS:	1245// 1825
VESSELS-RESIDUAL FUEL	329	3403	173	6	101	TON-MI(MLN)//DOCKD SHIPS:	762// 0
VESSELS-GASOLINE (BOATS)	5	5	886	2589	0	LAKE/BAY AREA (ACRES)	: 51627
SUBTOTAL-VESSELS	1541	3725	1283	3085	213		
FUEL HANDLING EVAPRTN	0	0	8769	0	0	THSNDS OF GALS FUEL USED:	1029100
TOTAL-TRANSPORTATION	86973	7903	93649	422343	8314		
SOLVENT EVAPRTN LOSS	0	0	2974	0	0	POPULATION	: 2192600
STRUCTURAL FIRES	10	0	19	241	81	POPULATION	
FOREST FIRES	9	0	55	333	39	FORESTED LAND (ACRES)	: 185000
AGRICULTURAL TILLING	0	0	0	0	570	ACRES//SILT//PE INDEX	: 59000//.38//83
UNPAVED ROADS	0	0	0	0	1363	MI(U/R)//SILT//WET DAYS	: 730/ 795//.38//63
REENTRNMNT-PAVED ROADS	0	0	0	0	6202	VMT ON PAVEMENT (MLN)	: 12404
TOTAL-MISCELLANEOUS	19	0	3049	574	8255		
GRAND TOTAL-AREA SOURCES	91986	10569	97671	429131	19663		

TABLE A-6. SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)

DATE 032976 PAGE 38

SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR) REGION: 7 COUNTY: LIBERTY YEAR: 1975

CATEGORY	NOX	SOX	HC	CO	PA	INPUT PARAMETERS	VALUES
RESDNTL FUEL-GAS	36	0	4	9	7	POPULATION :	34200
RESDNTL FUEL-DISTLT OIL	2	6	1	1	2	POPULATION	
RESDNTL FUEL-WOOD	3	0	6	76	26	POPULATION	
RESDNTL FUEL-ALL	41	6	10	86	35		
COMM-IND FUEL-GAS	29	0	2	4	3	POPLTN//GALS LPG(FARM) :	34200// 140000
COMM-IND FUEL-OIL	11	35	2	4	8	POPULATION	
COMM-IND FUEL-ALL	40	35	4	8	11		
TOTAL-FUEL COMBUSTION	81	41	14	94	46		
COMM-IND INCINERATION	1	1	1	3	2	POPULATION	
TOTAL-SOLID WASTE DSPSL	1	1	1	3	2		
LIGHT DUTY VEHCLS-GSLN	1884	54	2186	8896	189	VMT(U/R)//SPEED(U/R) :	131MLN/ 203MLN//35/50MPH
HEAVY DUTY VEHCLS-GSLN	236	6	324	1435	22	VMT(U/R)//SPEED(U/R) :	4MLN/ 12MLN//35/50MPH
MOTORCYCLES-GSLN	1	0	27	95	0	MOTORCYCLES REGISTERED :	704
OFF HIGHWAY-GSLN	41	1	87	1300	2	GAL FUEL(FARM//OTHER) :	372000// 140000
GSLN TRANSPRTN-TOTAL	2162	62	2624	11727	213		
HEAVY TRUCKS-DIESEL	532	54	49	154	41	VMT/(U/R)//SPEED(U/R) :	2MLN/ 16MLN//35/50MPH
OFF HIGHWAY-DIESEL	477	42	77	161	58	GAL FUEL(FARM//OTHER :	2093000// 555000
RAIL-DIESEL	396	62	101	139	27	THSNDS OF GALS FUEL USED:	2140
DIESEL TRANSPRTN-TOTAL	1406	158	226	454	125		
SUBTOTAL-LAND TRANSPRTN	3567	220	2850	12180	338		
CIVIL AIRCRAFT	1	0	1	54	0	LANDINGS/TAKEOFFS :	17800
VESSELS-DIESEL	2	0	0	1	0	TON-MI(MLN)//DOCKD SHIPS:	2// 0
VESSELS-GASOLINE (BOATS)	0	0	58	169	0	LAKE/BAY AREA (ACRES) :	3700
SUBTOTAL-VESSELS	2	1	58	170	0		
FUEL HANDLING EVAPRTN	0	0	318	0	0	THSNDS OF GALS FUEL USED:	33900
TOTAL-TRANSPORTATION	3570	221	3226	12404	338		
SOLVENT EVAPRTN LOSS	0	0	53	0	0	POPULATION :	34200
STRUCTURAL FIRES	0	0	0	4	1	POPULATION	
FOREST FIRES	23	0	136	817	95	FORESTED LAND (ACRES) :	454000
AGRICULTURAL TILLING	0	0	0	0	854	ACRES//SILT//PE INDEX :	84000//.40//83
UNPAVED ROADS	0	0	0	0	243	MI(U/R)//SILT//WET DAYS :	80/ 351//.40//67
REENTRNMNT-PAVED ROADS	0	0	0	0	181	VMT ON PAVEMENT (MLN) :	361
TOTAL-MISCELLANEOUS	23	0	189	821	1374		
GRAND TOTAL-AREA SOURCES	3674	263	3431	13322	1760		

TABLE A-7. SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)

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                                                                            DATE 032976        PAGE    53

     SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)              REGION: 7    COUNTY: MONTGOMERY         YEAR: 1975

          CATEGORY            NOX       SOX       HC        CO        PA      INPUT PARAMETERS           VALUES
---------------------------------------------------------------------------------------------------------------------------
RESDNTL FUEL-GAS               61         0         6        15        12     POPULATION              :   58200
RESDNTL FUEL-DISTLT OIL         3        10         1         2         3     POPULATION
RESDNTL FUEL-WOOD               5         0        10       130        44     POPULATION
RESDNTL FUEL-ALL               70        11        17       147        59

COMM-IND FUEL-GAS              44         0         3         7         5     POPLTN//GALS LPG(FARM)  :   58200//  105000
COMM-IND FUEL-OIL              18        59         4         6        14     POPULATION
COMM-IND FUEL-ALL              62        59         7        13        19

TOTAL-FUEL COMBUSTION         132        70        24       160        79

COMM-IND INCINERATION           1         1         2         5         3     POPULATION
TOTAL-SOLID WASTE DSPSL         1         1         2         5         3

LIGHT DUTY VEHCLS-GSLN       3928       110      4248     16135       390     VMT(U/R)//SPEED(U/R)    :  156MLN/ 533MLN//35/50MPH
HEAVY DUTY VEHCLS-GSLN        429        11       570      2489        39     VMT(U/R)//SPEED(U/R)    :    3MLN/  26MLN//35/50MPH
MOTORCYCLES-GSLN                2         0        77       273         1     MOTORCYCLES REGISTERED  :    2019
OFF HIGHWAY-GSLN               22         1        61       901         2     GAL FUEL(FARM//OTHER)   :   29000//  206000
GSLN TRANSPRTN-TOTAL         4380       123      4955     19798       432

HEAVY TRUCKS-DIESEL          1619       164       145       449       123     VMT/(U/R)//SPEED(U/R)   :    3MLN/  51MLN//35/50MPH
OFF HIGHWAY-DIESEL            199        16        21        56        16     GAL FUEL(FARM//OTHER    :  196000//  816000
RAIL-DIESEL                   462        72       117       162        31     THSNDS OF GALS FUEL USED:    2500
DIESEL TRANSPRTN-TOTAL       2280       252       284       667       171

SUBTOTAL-LAND TRANSPRTN      6660       375      5239     20466       603

CIVIL AIRCRAFT                  1         0         2        73         0     LANDINGS/TAKEOFFS       :   24100

VESSELS-GASOLINE (BOATS)        2         2       321       939         0     LAKE/BAY AREA (ACRES)   :   19610

FUEL HANDLING EVAPRTN           0         0       543         0         0     THSNDS OF GALS FUEL USED:   72100

TOTAL-TRANSPORTATION         6663       377      6105     21477       603

SOLVENT EVAPRTN LOSS            0         0        90         0         0     POPULATION              :   58200
STRUCTURAL FIRES                0         0         1         6         2     POPULATION
FOREST FIRES                   28         0       169      1015       118     FORESTED LAND (ACRES)   :  564000
AGRICULTURAL TILLING            0         0         0         0        18     ACRES//SILT//PE INDEX   :    2000//.40//67
UNPAVED ROADS                   0         0         0         0       262     MI(U/R)//SILT//WET DAYS :   29/ 600//.40//64
REENTRNMNT-PAVED ROADS          0         0         0         0       382     VMT ON PAVEMENT (MLN)   :     764
TOTAL-MISCELLANEOUS            28         0       260      1022       783

GRAND TOTAL-AREA SOURCES     6824       448      6391     22664      1468
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TABLE A-8. SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)

DATE 032976 PAGE 63

SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR) REGION: 7 COUNTY: WALLER YEAR: 1975

CATEGORY	NOX	SOX	HC	CO	PA	INPUT PARAMETERS	VALUES
RESDNTL FUEL-GAS	16	0	2	4	1	POPULATION :	15300
RESDNTL FUEL-DISTLT OIL	1	3	0	0	1	POPULATION	
RESDNTL FUEL-WOOD	1	0	3	14	12	POPULATION	
RESDNTL FUEL-ALL	18	3	5	19	16		
COMM-IND FUEL-GAS	14	0	1	2	1	POPLTN//GALS LPG(FARM) :	15300// 228000
COMM-IND FUEL-OIL	5	15	1	2	4	POPULATION	
COMM-IND FUEL-ALL	19	16	2	4	5		
TOTAL-FUEL COMBUSTION	37	18	6	42	21		
RESDNTL OPEN BURNING	7	1	34	98	18	POPULATION//OPN BRN FCTR:	15300// 100
COMM-IND OPEN BURNING	3	0	14	39	7	POPULATION//OPN BRN FCTR	
COMM-IND INCINERATION	0	0	0	1	1	POPULATION	
TOTAL-SOLID WASTE DSPSL	10	2	49	138	27		
LIGHT DUTY VEHCLS-GSLN	934	29	1042	4121	96	VMT(U/R)//SPEED(U/R) :	53MLN/ 133MLN//35/50MPH
HEAVY DUTY VEHCLS-GSLN	140	4	206	856	13	VMT(U/R)//SPEED(U/R) :	1MLN/ 8MLN//35/50MPH
MOTORCYCLES-GSLN	0	0	8	29	0	MOTORCYCLES REGISTERED :	213
OFF HIGHWAY-GSLN	19	1	42	610	1	GAL FUEL(FARM//OTHER) :	193000// 46000
GSLN TRANSPRTN-TOTAL	1094	34	1298	5617	110		
HEAVY TRUCKS-DIESEL	412	42	37	116	31	VMT/(U/R)//SPEED(U/R) :	1MLN/ 13MLN//35/50MPH
OFF HIGHWAY-DIESEL	235	21	39	81	30	GAL FUEL(FARM//OTHER :	1136000// 182000
RAIL-DIESEL	348	55	88	122	24	THSNDS OF GALS FUEL USED:	1880
DIESEL TRANSPRTN-TOTAL	995	117	165	319	84		
SUBTOTAL-LAND TRANSPRTN	2088	151	1463	5935	194		
CIVIL AIRCRAFT	0	0	0	4	0	LANDINGS/TAKEOFFS :	1600
FUEL HANDLING EVAPRTN	0	0	184	0	0	THSNDS OF GALS FUEL USED:	19300
TOTAL-TRANSPORTATION	2088	151	1647	5939	194		
SOLVENT EVAPRTN LOSS	0	0	24	0	0	POPULATION :	15300
STRUCTURAL FIRES	0	0	0	2	1	POPULATION	
FOREST FIRES	3	0	18	110	13	FORESTED LAND (ACRES) :	61000
AGRICULTURAL TILLING	0	0	0	0	527	ACRES//SILT//PE INDEX :	57000//.40//87
UNPAVED ROADS	0	0	0	0	155	MI(U/R)//SILT//WET DAYS :	36/ 275//.40//61
REENTRNMNT-PAVED ROADS	0	0	0	0	103	VMT ON PAVEMENT (MLN) :	206
TOTAL-MISCELLANEOUS	3	0	42	111	798		
GRAND TOTAL-AREA SOURCES	2138	171	1744	6231	1040		

TABLE A-9. SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)

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SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR) REGION: 10 COUNTY: JEFFERSON YEAR: 1975

CATEGORY	NOX	SOX	HC	CO	PA	INPUT PARAMETERS	VALUES
RESDNTL FUEL-GAS	262	2	26	66	52	POPULATION	: 250300
RESDNTL FUEL-DISTLT OIL	15	44	4	7	13	POPULATION	
RESDNTL FUEL-WOOD	22	0	45	559	190	POPULATION	
RESDNTL FUEL-ALL	299	46	75	631	255		
COMM-IND FUEL-GAS	191	1	13	31	23	POPLTN//GALS LPG(FARM)	: 250300// 87000
COMM-IND FUEL-OIL	79	253	16	26	61	POPULATION	
COMM-IND FUEL-ALL	269	254	29	57	84		
TOTAL-FUEL COMBUSTION	568	300	103	689	339		
COMM-IND INCINERATION	6	5	8	21	15	POPULATION	
TOTAL-SOLID WASTE DSPSL	6	5	8	21	15		
LIGHT DUTY VEHCLS-GSLN	7169	212	10066	54866	789	VMT(U/R)//SPEED(U/R)	: 1141MLN/ 252MLN//30/50MPH
HEAVY DUTY VEHCLS-GSLN	692	20	1143	6099	68	VMT(U/R)//SPEED(U/R)	: 34MLN/ 17MLN//30/50MPH
MOTORCYCLES-GSLN	7	1	276	982	5	MOTORCYCLES REGISTERED	: 7272
OFF HIGHWAY-GSLN	101	5	293	4124	7	GAL FUEL(FARM//OTHER)	: 461000// 621000
GSLN TRANSPRTN-TOTAL	7969	239	11779	66070	870		
HEAVY TRUCKS-DIESEL	1525	161	162	630	121	VMT/(U/R)//SPEED(U/R)	: 23MLN/ 29MLN//30/50MPH
OFF HIGHWAY-DIESEL	944	79	126	292	96	GAL FUEL(FARM//OTHER	: 2568000// 2450000
RAIL-DIESEL	546	86	139	192	37	THSNDS OF GALS FUEL USED	: 2950
DIESEL TRANSPRTN-TOTAL	3015	325	427	1113	253		
SUBTOTAL-LAND TRANSPRTN	10984	564	12206	67184	1123		
MILITARY AIRCRAFT	54	0	68	509	0	LANDINGS/TAKEOFFS	: 6700
CIVIL AIRCRAFT	18	1	23	609	1	LANDINGS/TAKEOFFS	: 186900
COMMERCIAL ACFT	33	6	41	130	4	LANDINGS/TAKEOFFS	: 15700
SUBTOTAL-AVIATION	105	7	132	1248	5		
VESSELS-DIESEL	1068	281	198	434	99	TON-MI(MLN)//DOCKD SHIPS	: 1417// 782
VESSELS-RESIDUAL FUEL	348	3451	183	8	110	TON-MI(MLN)//DOCKD SHIPS	: 1118// 0
VESSELS-GASOLINE (BOATS)	1	1	113	331	0	LAKE/BAY AREA (ACRES)	: 7284
SUBTOTAL-VESSELS	1416	3733	495	773	209		
FUEL HANDLING EVAPRTN	0	0	1139	0	0	THSNDS OF GALS FUEL USED	: 127800
TOTAL-TRANSPORTATION	12505	4304	13971	69204	1337		
SOLVENT EVAPRTN LOSS	0	0	386	0	0	POPULATION	: 250300
STRUCTURAL FIRES	1	0	2	28	9	POPULATION	
FOREST FIRES	3	0	16	97	11	FORESTED LAND (ACRES)	: 54000
AGRICULTURAL TILLING	0	0	0	0	634	ACRES//SILT//PE INDEX	: 78000//.32//83
UNPAVED ROADS	0	0	0	0	124	MI(U/R)//SILT//WET DAYS	: 59/ 110//.32//71
REENTRNMNT-PAVED ROADS	0	0	0	0	746	VMT ON PAVEMENT (MLN)	: 1492
TOTAL-MISCELLANEOUS	4	0	405	125	1525		
GRAND TOTAL-AREA SOURCES	13082	4608	14487	70039	3215		

TABLE A-10. SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR)

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SUMMARY OF EMISSIONS FROM AREA TYPE SOURCES (TONS/YR) REGION: 10 COUNTY: ORANGE YEAR: 1975

CATEGORY	NOX	SOX	HC	CO	PA	INPUT PARAMETERS	VALUES
RESDNTL FUEL-GAS	81	0	8	20	16	POPULATION :	77600
RESDNTL FUEL-DISTLT OIL	5	14	1	2	4	POPULATION	
RESDNTL FUEL-WOOD	7	0	14	173	59	POPULATION	
RESDNTL FUEL-ALL	93	14	23	196	79		
COMM-IND FUEL-GAS	58	0	4	10	7	POPLTN//GALS LPG(FARM) :	77600// 17000
COMM-IND FUEL-OIL	24	78	5	8	19	POPULATION	
COMM-IND FUEL-ALL	82	79	9	18	26		
TOTAL-FUEL COMBUSTION	175	93	32	213	105		
COMM-IND INCINERATION	2	1	2	6	4	POPULATION	
TOTAL-SOLID WASTE DSPSL	2	1	2	6	4		
LIGHT DUTY VEHCLS-GSLN	2483	71	3191	16357	265	VMT(U/R)//SPEED(U/R) :	299MLN/ 167MLN//30/50MPH
HEAVY DUTY VEHCLS-GSLN	199	7	444	2003	23	VMT(U/R)//SPEED(U/R) :	8MLN/ 10MLN//30/50MPH
MOTORCYCLES-GSLN	2	0	83	295	2	MOTORCYCLES REGISTERED :	2183
OFF HIGHWAY-GSLN	17	1	70	908	2	GAL FUEL(FARM//OTHER) :	29000// 111000
GSLN TRANSPRTN-TOTAL	2700	80	3788	19562	291		
HEAVY TRUCKS-DIESEL	721	75	71	249	56	VMT/(U/R)//SPEED(U/R) :	6MLN/ 18MLN//30/50MPH
OFF HIGHWAY-DIESEL	119	10	13	34	10	GAL FUEL(FARM//OTHER :	169000// 441000
RAIL-DIESEL	431	68	109	151	29	THSNDS OF GALS FUEL USED:	2330
DIESEL TRANSPRTN-TOTAL	1271	152	193	434	95		
SUBTOTAL-LAND TRANSPRTN	3971	231	3981	19996	386		
CIVIL AIRCRAFT	1	0	1	59	0	LANDINGS/TAKEOFFS :	17800
VESSELS-DIESEL	264	69	49	108	24	TON-MI(MLN)//DOCKD SHIPS:	383// 22
VESSELS-RESIDUAL FUEL	1	8	0	0	0	TON-MI(MLN)//DOCKD SHIPS:	0// 0
SUBTOTAL-VESSELS	264	78	49	108	24		
FUEL HANDLING EVAPRTN	0	0	364	0	0	THSNDS OF GALS FUEL USED:	44300
TOTAL-TRANSPORTATION	4236	309	4395	20163	411		
SOLVENT EVAPRTN LOSS	0	0	120	0	0	POPULATION :	77600
STRUCTURAL FIRES	0	0	1	9	3	POPULATION	
FOREST FIRES	7	0	43	261	30	FORESTED LAND (ACRES) :	145000
AGRICULTURAL TILLING	0	0	0	0	61	ACRES//SILT//PE INDEX :	6000//.40//83
UNPAVED ROADS	0	0	0	0	90	MI(U/R)//SILT//WET DAYS :	37/ 104//.40//71
REENTRNMNT-PAVED ROADS	0	0	0	0	253	VMT ON PAVEMENT (MLN) :	505
TOTAL-MISCELLANEOUS	8	0	164	270	437		
GRAND TOTAL-AREA SOURCES	4421	403	4594	20652	957		